

# Bulletin Board

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JUL. 09, 2021

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

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### ASIA PACIFIC

#### AICIS glossary

2021-07-02

Our glossary can help you quickly find out what a term means and where and how we use it.

<https://www.industrialchemicals.gov.au/glossary>

Australian Government Department of Health, 2 July 2021

<https://www.industrialchemicals.gov.au/glossary>

#### Correction of chemical names

2021-06-22

Inventory notices

We have updated the names of some chemicals in the Inventory to the Chemical Abstracts Service (CAS) name. These corrections do not change the identity of the chemical substances themselves.

[Read More](#)

Industrialchemicals.gov, 22 June 2021

<https://www.industrialchemicals.gov.au/news-and-notice/correction-chemical-names-22-june-2021>

#### Industrial chemicals environmental management standard - IChEMS

2021-07-02

Improving chemicals regulation

The Australian Government is strengthening chemicals management laws to protect our land, air and water.

We have established the Industrial Chemicals Environmental Management Standard – or IChEMS – to help industry and governments manage the environmental risks of chemicals.

IChEMS will provide a national approach to how chemicals can be used, stored, handled and disposed of.

This work will be delivered in two stages.

**Our glossary can help you quickly find out what a term means and where and how we use it.**

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**Phase 1** included the creation of legislation. The [Industrial Chemicals Environment Management \(Register\) Bill 2020](#)

(link is external)

passed both houses of parliament on 18 March 2021.

An IChEMS register will now be established to create a single consistent source of information on how chemicals should be managed.

Chemicals will be categorised and scheduled on the IChEMS register based on their level of concern to the environment. This will help government, industry and the community make informed choices about chemicals.

In **phase 2**, the IChEMS register will be incorporated into the laws of each jurisdiction.

This means environmental risks will be managed consistently across states and territories and on Commonwealth land.

A consistent system to regulate chemicals will result in better protection of human health and the environment. It will make it easier and more efficient for industry to manage chemical risks.

[Read More](#)

Australian Department of Health, 2 July 2021

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

### AMERICA

#### Salon workers are holding on to their masks, and not just because of Covid-19

2021-06-20

Cosmetology workers are reassessing their jobs, including the chemicals they're exposed to.

Stylist Michele Ortiz has no plans to get rid of her personal protective equipment, even as Covid-19 protocols are rescinded in [California](#) and other states. "I would love to see hairdressers wearing their masks even after the pandemic, whenever all of this subsides," Ortiz says.

**"I would love to see hairdressers wearing their masks even after the pandemic, whenever all of this subsides," Ortiz says.**

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For years, the California hairstylist experienced nosebleeds, lightheadedness, hot flashes, and rosacea as a result of the harsh chemicals used in hair color services. But now she refuses to use such chemicals, and after arriving for work at Phenix Salon Suites in Santa Barbara, she dons a mask, rubber gloves, and a face shield, and switches on an air purifier to counteract the chemicals used by a coworker. She feels safer this way, and not just from the virus.

Workers across the cosmetology industry, including spa, hair, and nail salon employees, have expressed workplace safety concerns before and during the Covid-19 pandemic. According to complaints filed by cosmetology workers to the Occupational Safety and Health Administration (OSHA) between January 2015 and July 2020 — obtained via Freedom of Information Act requests in partnership with the [Economic Hardship Reporting Project](#) and then shared with Vox — exposure to these chemicals, especially in salons with poor ventilation or whose owners failed to provide PPE, resulted in burning eyes, breathing problems, rashes, and more.

Now that salons have reopened and the CDC updated its [guidelines](#) to say fully vaccinated people can resume activities without practicing social distancing or wearing masks, cosmetology workers must navigate both the immediate threat of Covid-19 and the ongoing risks of cosmetic chemical exposures.

[Read More](#)

Vox, 20 June 2021

<https://www.vox.com/the-goods/22538694/salon-workers-covid-chemicals-hair-nails-keratin-masks>

### 5 US states now ban PFAS in food packaging

2021-06-22

On June 9, 2021, the US state of Connecticut passed [Bill No. 926](#) prohibiting the “sale of consumer packaging that contains per- and polyfluoroalkyl substances (PFAS).” The bill was unanimously passed by the state’s senate, and Governor Ted Lamont is expected to soon sign it into law. After January 2024, no manufacturer, supplier, or distributor will be allowed to sell PFAS-containing packaging within the state. Connecticut will become the fifth US state to ban PFAS in food packaging (FPF [reported](#), also [here](#) and [here](#)).

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On May 19, the US state of Vermont also established a [ban of PFAS](#) in food packaging when it passed the largest, most comprehensive piece of PFAS legislation seen so far in the country. In addition to banning PFAS in packaging and firefighting foam, Vermont’s legislation applies to many household products. Bisphenols (FPF [reported here](#) and [here](#)) are also included in the statute. The new legislation allows the state’s Department of Health to ban bisphenols in food packaging if “a safer alternative is readily available in sufficient quantity and at a comparable cost ... [and] performs as well as or better than bisphenols in a specific application.” The law goes into effect July 1, 2021 with restrictions to be phased in over the next several years.

[Read More](#)

Food Packaging Forum, 22 June 2021

<https://www.foodpackagingforum.org/news/5-us-states-now-ban-pfas-in-food-packaging>

### The Department of Yes: How Pesticide Companies Corrupted the EPA and Poisoned America

2021-07-01

**ANNE SHEPPARD WAS** sitting in her office on a Friday afternoon when a colleague approached her with an old study on the safety of chlorpyrifos. Throughout the 1980s and 1990s, the Environmental Protection Agency had used the study to set a safety level for the exposure to the pesticide, which is widely used on fruits and vegetables. But when Sheppard, a professor and biostatistician at the University of Washington, looked at the original research that was the basis for the paper and the safety thresholds that were calculated from it, she realized that the underlying data didn’t support its conclusion.

“I tried to reproduce their analysis, and I couldn’t,” Sheppard said of the study, which was commissioned by Dow Chemical, the maker of chlorpyrifos, in the late 1960s. The research was conducted by an Albany Medical College professor named Frederick Coulston, who exposed 16 incarcerated men to the pesticide, dividing them into four groups — a low-, medium-, and high-dose group as well as a control — and recording their nervous system responses. The resulting paper, which was written by Dow statisticians based on Coulston’s data, concluded that at the highest dose the pesticide depressed the activity of cholinesterase, an enzyme necessary for neuromuscular function. Sheppard was able to confirm that

**“I tried to reproduce their analysis, and I couldn’t,” Sheppard said of the study, which was commissioned by Dow Chemical, the maker of chlorpyrifos, in the late 1960s.**

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finding. But while Dow concluded that the middle- and low-range doses had no effect, Sheppard found effects in both groups. She also saw how Dow had used the paper to help the EPA set an incorrect “no-effects level,” or NOEL, which is critical for calculating a safety threshold.

“I realized that in the middle-dose group, which is the one that mattered for the no-effects level, they had conveniently left out one of the two baseline measurement days,” said Sheppard. “The outrageous thing was that the group they declared as NOEL was only that because they left out data from their analysis.” In a peer-reviewed paper published in October 2020, Sheppard and her colleagues concluded that “the omission of valid data without justification was a form of data falsification.”

[Read More](#)

The Intercept, 1 July 2021

<https://theintercept.com/2021/06/30/epa-pesticides-exposure-opp/>

### New bill aims to improve water quality in New York schools

2021-06-29

A new bill aiming to improve drinking water quality in New York schools will soon be delivered to Gov. Andrew Cuomo for approval after it passed in both the state senate and assembly.

Assembly Speaker Carl Heastie and Health Committee Chair Richard N. Gottfried announced Monday that the Assembly passed legislation to improve water quality in schools by strengthening water testing requirements for lead. That includes increasing the frequency of testing, removing testing exemptions, and lowering lead action levels.

“Experts agree that there is no safe level of lead for children, and high levels of lead can be even more devastating for them,” said Heastie, in a press release. “This legislation would ensure that appropriate testing is done on a regular basis with no exceptions, and that the data collected is made public and any issues are remedied.”

The legislation would ensure that drinking water in schools is safe and free of lead contamination. Children are particularly vulnerable to the harmful effects of lead — and the American Academy of Pediatrics, the Centers for Disease Control and Prevention, and the World Health Organization say there is no safe level of lead for children.

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[Read More](#)

Sillive, 29 June 2021

<https://www.silive.com/education/2021/06/new-bill-aims-to-improve-water-quality-in-new-york-schools.html>

### EUROPE

#### EC committee needs more data to assess safety of the nanomaterials gold, colloidal gold, and surface modified gold

2021-07-01

The European Commission’s (EC) Scientific Committee on Consumer Safety (SCCS) published a [final opinion](#) on June 28, 2021, on gold (nano), colloidal gold (nano), gold thioethylamino hyaluronic acid (nano), and acetyl heptapeptide-9 colloidal gold (nano). The EC asked SCCS whether the nanomaterials gold, colloidal gold, gold thioethylamino hyaluronic acid, and acetyl heptapeptide-9 colloidal gold are safe when used in leave-on skin cosmetic products according to the maximum concentrations and specifications, taking into account reasonably foreseeable exposure conditions. SCCS states that it considered all the information provided by the notifiers “and is of the opinion that it is not possible to carry out safety assessment of the nanomaterials (Gold, Colloidal Gold and Surface Modified Gold) due to limited or missing essential information.” According to SCCS, much of the information provided on toxicity relates to gold as such, and it is not possible to determine the relevance of the data for nanoforms of any of the materials under the current evaluation due to the absence of full study reports. To conduct a safety assessment of the nanomaterials, detailed data and information need to be provided on physicochemical characterization and toxicological evaluation. The final opinion states that with regard to surface modified gold, all notifications relating to acetyl heptapeptide-9 colloidal gold (nano) were withdrawn by the notifiers and therefore only gold thioethylamino hyaluronic acid is considered in the opinion.

**To conduct a safety assessment of the nanomaterials, detailed data and information need to be provided on physicochemical characterization and toxicological evaluation.**

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### [Read More](#)

Nano and Other Emerging Technologies Blog, 1 July 2021

<https://nanotech.lawbc.com/2021/07/ec-committee-needs-more-data-to-assess-safety-of-the-nanomaterials-gold-colloidal-gold-and-surface-modified-gold>

### **EC office: No 'major overhaul' of cosmetics regulation planned under European Green Deal**

2021-06-30

The European Green Deal will see plenty of strategies and legislation rolled out to slash carbon emissions, phase out harmful chemicals and drive circular business models, but there will be no major overhaul to the existing EU Cosmetics Regulation, according to deputy director-general of the European Commission's Department for Growth (DG Grow).

### [Read More](#)

Cosmetics Design Europe, 30 June 2021

<https://www.cosmeticsdesign-europe.com/Article/2021/06/30/European-Commission-will-not-majorly-overhaul-Cosmetics-Regulation-under-European-Green-Deal>

## INTERNATIONAL

### **Review: WHO report raises concerns about the effects of e-waste exposure on Child Health**

2021-07-01

The WHO recently released a report that outlines the link between informal e-waste recycling activities and health outcomes in children. As per this report, 18 million children & 12.9 million women, may be at risk from adverse health outcomes linked to e-waste recycling. Here is a review with a focus on India.

e-waste or electronic waste refers to all the electrical and electronic equipment and their components which have been discarded as waste. With the advancement in technology and the increasing usage of electronic products for multiple needs, it is no surprise that the generation of e-waste is increasing at a rapid pace. Peoples' insatiable demand, technology uptake and shorter replacement cycles are some of the

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reasons behind the exponential growth in e-waste. In Europe, USA, and China, the average mobile phone is disposed of in less than two years. Even the United Nations has repeatedly warned that a 'Tsunami of e-waste' would hit the world soon.

According to World Economic Forum's report in 2019, the e-waste produced annually was worth over \$ 62.5 billion, more than the GDP of most countries. In addition to being a huge environmental problem, millions of children are affected by the mounting e-waste. This story reviews the recent report on e-waste and child health- 'Children and digital dumpsites: e-waste exposure and child health', published by WHO.

### [Read More](#)

Factly, 1 July 2021

<https://factly.in/review-who-report-raises-concerns-about-the-effects-of-e-waste-exposure-on-child-health/>

### **Apple and the ChemSec Business Group share innovative approach for improving chemical safety**

2021-06-30

ChemSec, in collaboration with Apple and other corporate members in the NGO's Business Group, has developed a step-by-step approach to help companies advance chemical safety within their products and supply chains. ChemCoach, published today, provides a framework to identify, phase out, and replace harmful chemicals with safer alternatives. This resource is now available publicly and free of charge.

This information sharing initiative was developed under the leadership of the NGO ChemSec, whose mission is to influence companies to reduce the use of hazardous chemicals in everyday products. Apple and other companies at the forefront of sustainable chemicals management routinely meet under the ChemSec umbrella to develop practices that support sustainable chemistry. This project is one of the outcomes of this collaboration.

### **Providing a Foundation For Smart Chemistry**

ChemCoach is a checklist and flowchart to help companies identify and move toward replacing Endocrine-Disrupting Chemicals (EDCs) in their products and supply chains. The guidance of ChemCoach builds on the previous experiences of Apple and other participating companies that are

**This resource is now available publicly and free of charge.**

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leading in smart chemistry solutions that protect the health of consumers and the environment.

*"Chemicals safety is a global, shared responsibility, so ChemSec is thrilled to have Apple and other industry leaders join in sharing these practical tools for adopting sustainable practices," says Anne-Sofie Bäckar, Executive Director at ChemSec.*

*"We hope this resource inspires more companies within the manufacturing industry to maximize the safety of their operations and products."*

*"Implementing smart chemistry solutions is a core component of Apple's goal to ensure our products are safe for the environment, our customers, supply chain, and employees," says Art Fong, Environmental Technologies Smarter Chemistry Lead at Apple.*

*"We're proud of our ongoing collaboration with ChemSec to develop and share best practices on chemical safety that will support the health of our communities and the planet we all share."*

### [Read More](#)

ChemSec, 30 June 2021

<https://chemsec.org/apple-and-the-chemsec-business-group-share-innovative-approach-for-improving-chemical-safety/>

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## REACH Update

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### Discussion on polymer registration under REACH goes into 4<sup>th</sup> round

2021-06-23

EU Competent Authorities for REACH and CLP (CARACAL) subgroup members debate on the identification of polymers requiring registration and their grouping; consider different opinions of stakeholders on group size, acceptable hazard variation within a group and options to deal with the variety of molecular weights one polymer can have; discussions to continue until end of 2021.

In the fourth meeting of the *EU Competent Authorities for REACH and CLP (CARACAL)* subgroup on polymers held online on June 22, 2021, the grouping of polymers requiring registration under REACH (FPF [reported](#)) and their joint submission was discussed in detail.

Currently estimated at 200,000, the number of polymers on the EU market is considered very high. Grouping them is therefore intended to help manage polymers in a cost-effective way that limits the burden on industry and reduces animal testing while providing a higher level of protection for human and environmental health. During the fourth meeting of the *CARACAL* subgroup on polymers, EU member states, industry representatives, and NGOs agreed that it is crucial to define clear group boundaries, e.g., to avoid group splitting after registration, and to consider animal welfare throughout the entire process. However, there was disagreement between stakeholders on the group size, which defines the number of polymers in one group. Questions discussed in this regard included: Which degree of hazard heterogeneity within a group is acceptable? What are the options to consider the different molecular weights of one polymer in grouping and registration since hazard properties are assumed to change with the molecular weight?

A generic challenge in polymer registration under REACH is that hazard data is missing for most polymers. This is also one of the reasons why *ECHA* has [proposed](#) to use "similar chemical composition as the main grouping principle," which would "have the [further] benefit of consistency with existing REACH criteria."

Other agenda points discussed during the meeting without yet reaching a consensus included the *EC's* proposal for an [EU definition of polymers of low concern](#) as well as the *EC's* proposed [flowchart](#) to identify polymers requiring registration. As part of each meeting, *ECHA* also [reported](#) the current status and lessons learned from pilots in which *ECHA* works

**Currently estimated at 200,000, the number of polymers on the EU market is considered very high.**

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together with five industry sector groups. The objective is to verify the technical grouping principles, elaborate on different grouping principles, and evaluate existing groups' hazards.

By the end of 2021, the CARACAL subgroup on polymers is mandated to advise the *European Commission* in its development of a proposal for polymer registration under REACH. Given the lack of consensus in the discussions so far, debates are expected to continue.

[Read More](#)

Food Packaging Forum, 23 June 2021

<https://www.foodpackagingforum.org/news/discussion-on-polymer-registration-under-reach-goes-into-4th-round>

### Upcoming changes to REACH information requirements

2021-06-29

The European Commission has revised certain information requirements for registering chemicals under REACH. The changes will start to apply in early 2022 and companies need to start preparing. ECHA will publish more advice in late 2021.

Helsinki, 29 June 2021 - The update of the REACH annexes clarifies the information companies need to submit in their registrations and makes ECHA's evaluation practices more transparent and predictable. The law comes into effect on 8 July 2021 and will apply from 8 January 2022.

The main changes concern:

- requirements for surface tension and water solubility of metals and sparingly soluble metal compounds;
- requirements for *in vitro* testing for eye irritation and *in vivo* testing for skin or eye irritation;
- requirements and adaptations for 28-day and 90-day repeated dose toxicity studies;
- specific rules for adapting reproductive toxicity studies;
- general rules for adaptation based on:
  - use of existing data;
  - weight of evidence;
  - substance-tailored exposure-driven testing; and

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- grouping of substances – in particular, those of unknown or variable composition, complex reaction products and biological materials (UVCBs);
- new rules for adapting studies on fate and behaviour in the environment based on a low octanol-water partition coefficient;
- new specific rules for adapting for dissociation constant and viscosity; and
- additional requirements for human health and environmental testing to be performed at appropriately high dose levels.

ECHA is updating its guidance materials and will publish more advice to registrants towards the end of 2021.

[Read More](#)

ECHA, 29 June 2021

<https://echa.europa.eu/-/upcoming-changes-to-reach-information-requirements>

**The changes will start to apply in early 2022 and companies need to start preparing.**



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## Janet's Corner

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## Solid Liquid Gas

2021-07-09



<https://teathattast.tumblr.com/post/183233307775/its-science>

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## Hazard Alert

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## Diazinon

2021-07-09

Diazinon (IUPAC name: O,O-Diethyl O-[4-methyl-6-(propan-2-yl)pyrimidin-2-yl] phosphorothioate), a colourless to dark brown liquid, is a thiophosphoric acid ester developed in 1952 by Ciba-Geigy, a Swiss chemical company. It is a non-systemic organophosphate insecticide formerly used to control cockroaches, silverfish, ants, and fleas in residential, non-food buildings. Diazinon was heavily used during the 1970s and early 1980s for general-purpose gardening use and indoor pest control. A bait form was used to control scavenger wasps in the western U.S. In 2004, residential use of diazinon was banned but it is still approved for agricultural uses. Diazinon kills insects by inhibiting acetylcholinesterase, an enzyme necessary for proper nervous system function. It has a low persistence in soil, with a half-life of between 2 to 6 weeks.[1]

## USES [2]

Diazinon is used throughout the world to control a wide range of sucking and chewing insects and mites on a range of crops, including deciduous fruit trees, citrus fruit, bananas, vegetables, potatoes, beet, sugar cane, coffee, cocoa, tea, tobacco, cotton, and rice. It is also used to control agricultural soil-dwelling insects, and is applied as a sheep dip to control ectoparasites such as sheep scab and blow fly strike. Diazinon use in homes controls cockroaches, ants, and carpet beetles, and is in insecticidal pet collars.[2]

## IN THE ENVIRONMENT [3]

- Diazinon can be released into the environment during its production and use as a pesticide.
- Diazinon is moderately persistent and mobile in the environment.
- In air, diazinon is relatively quickly transformed into diazoxon; the estimated half-life for this reaction is 4 hours.
- Diazinon released to surface water or soil is subject to volatilisation, photolysis, hydrolysis, and biodegradation.
- The half-life of diazinon ranges from approximately 70 hours to 12 weeks in surface water and 10 to 200 days in soil.
- Diazinon does not bioaccumulate in aquatic organisms.

**Diazinon (IUPAC name: O,O-Diethyl O-[4-methyl-6-(propan-2-yl)pyrimidin-2-yl] phosphorothioate), a colourless to dark brown liquid, is a thiophosphoric acid ester developed in 1952 by Ciba-Geigy, a Swiss chemical company.**

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### SOURCES OF EXPOSURE [3]

- The general population may be exposed via diazinon-contaminated air, water, or food, but there is little potential for high level exposure because home and garden uses for diazinon have been banned.
- Significant inhalation exposure is likely only near areas where diazinon is produced or used as a restricted pesticide.
- Oral exposure may occur by drinking contaminated water or eating foods containing diazinon residue.
- Significant dermal exposure is likely only near areas where diazinon may be used as a restricted pesticide.
- Occupational exposure may occur at facilities that produce diazinon or in working environments where diazinon is used as a pesticide. Inhalation and dermal exposure are the predominant routes of exposure for workers during production, handling, and application.

### HEALTH EFFECTS [4]

#### Acute toxicity

The World Health Organisation (WHO) classifies diazinon as a class II 'moderately hazardous' pesticide. The acute oral LD50 (the dose required to kill half a population of laboratory animals) for rats is 1,250 mg/kg, and for mice it is 80-135 mg/kg(12). Diazinon, poisons humans and insects through its effects on nerve enzymes. It combines chemically with the acetylcholinesterase enzyme and inactivates it. This enzyme is essential for the control of nerve impulse transmission. Loss of acetylcholinesterase allows the accumulation of acetylcholine, the substance secreted by nerves that activates muscles, glands, and other nerves. Accumulation of sufficient levels of acetylcholine at junctions between nerves muscles will cause muscle contractions or twitching. Accumulation of acetylcholine at junctions between nerves and glands results in gland secretion; and accumulation between nerves in the brain causes sensory and behavioural disturbances. The main symptoms of acute diazinon poisoning are headache, nausea, dizziness, pin-point pupils, blurred vision, tightness in the chest, difficulty in breathing, muscle weakness or twitching, difficulty in walking, vomiting, abdominal cramps, and diarrhoea. Effects on the central nervous system may include confusion, anxiety, drowsiness, depression, difficulty in concentrating, slurred speech, poor recall, insomnia, nightmares, and a form of toxic psychosis resulting in bizarre behaviour.

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### Chronic toxicity

Based on inhibition of the enzyme acetylcholinesterase, the daily administered no-observed-adverse-effect-level (NOAEL) for humans is 0.025 mg/kg body weight per day, according to WHO. Other reports suggest no-effect doses have ranged from 0.02 mg/kg/day in humans to 0.1 mg/kg/day in rats(20). In sub-chronic and chronic toxicity studies conducted in mice, rats and dogs, systemic toxicity occurred with decreases in body weight and body weight gains. There are also potential concerns about breakdown products. In animals diazinon is converted to diazoxon (where the sulphur molecule is substituted for oxygen), a compound that is a strong enzyme inhibitor.

### Cancer

Diazinon is not considered carcinogenic by agencies such as the International Agency for the Research on Cancer, or the US EPA. However, use of diazinon by farmers in Iowa and Minnesota has been linked to increased risk of non-Hodgkins lymphoma, a rare form of cancer. Similar links were found in the 1980s in Nebraska.

### SAFETY [5]

#### First Aid Measures

- Call a poison control centre or doctor immediately for treatment advice.
- If swallowed: Have a person sip a glass of water if able to swallow. Do not induce vomiting unless told to do so by a poison control centre or doctor. Do not give anything by mouth to an unconscious person.
- If on skin or clothing: Take off contaminated clothing. Rinse skin immediately with plenty of water for 15 to 20 minutes.
- If inhaled: Move person to fresh air. If person is not breathing, call 000 or an ambulance, then give artificial respiration, preferably mouth-to-mouth if possible.
- If in eyes: Hold eye open and rinse slowly and gently with water for 15-20 minutes. Remove contact lenses, if present, after the first 5 minutes, then continue rinsing eye.

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### Exposure Controls/Personal Protection

- Engineering Controls: When handlers use closed systems, enclosed cabs, or aircraft in a manner that meets with requirements listed in the Worker Protection Standard (WPS) for agricultural pesticides [40CFR 170.240 (d)(4-6)], the handler PPE requirements may be reduced or modified as specified in the WPS.
- Respiratory Protection: Not normally required, if vapours exceed acceptable levels, wear a MSHA/NIOSH approved pesticide respirator with cartridges for pesticide vapours.
- Eye Protection: Chemical goggles or shielded safety glasses.
- Skin Protection: Wear protective clothing: long-sleeved shirts and pants, hat, rubber boots with socks. Wear rubber or chemical resistant gloves.

### REFERENCES

1. <http://en.wikipedia.org/wiki/Diazinon>
2. <http://www.pan-uk.org/pestnews/Actives/diazinon.htm>
3. <http://www.atsdr.cdc.gov/toxguides/toxguide-86.pdf>
4. <http://www.pan-uk.org/pestnews/Actives/diazinon.htm>
5. <http://www.uap.ca/products/documents/Diazinon5GPCP12538.pdf>

# Bulletin Board

## Gossip

JUL. 09, 2021

### Protein 'big bang' reveals molecular makeup for medicine and bioengineering

2021-06-30

Proteins have been quietly taking over our lives since the COVID-19 pandemic began. We've been living at the whim of the virus's so-called "spike" protein, which has mutated dozens of times to create increasingly deadly variants. But the truth is, we have always been ruled by proteins. At the cellular level, they're responsible for pretty much everything.

Proteins are so fundamental that DNA—the genetic material that makes each of us unique—is essentially just a long sequence of protein blueprints. That's true for animals, plants, fungi, bacteria, archaea, and even viruses. And just as those groups of organisms evolve and change over time, so too do proteins and their component parts.

A new study from University of Illinois researchers, published in *Scientific Reports*, maps the evolutionary history and interrelationships of protein domains, the subunits of protein molecules, over 3.8 billion years.

"Knowing how and why domains combine in proteins during evolution could help scientists understand and engineer the activity of proteins for medicine and bioengineering applications. For example, these insights could guide disease management, such as making better vaccines from the spike protein of COVID-19 viruses," says Gustavo Caetano-Anollés, professor in the Department of Crop Sciences, affiliate of the Carl R. Woese Institute for Genomic Biology at Illinois, and senior author on the paper.

Caetano-Anollés has studied the evolution of COVID mutations since the early stages of the pandemic, but that timeline represents a vanishingly tiny fraction of what he and doctoral student Faye Aziz took on in their current study.

The researchers compiled sequences and structures of millions of protein sequences encoded in hundreds of genomes across all taxonomic groups, including higher organisms and microbes. They focused not on whole proteins, but instead on structural domains.

"Most proteins are made of more than one domain. These are compact structural units, or modules, that harbor specialized functions," Caetano-Anollés says. "More importantly, they are the units of evolution."

After sorting proteins into domains to build evolutionary trees, they set to work building a network to understand how domains have developed and been shared across proteins throughout billions of years of evolution.

**But the truth is, we have always been ruled by proteins.**

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“We built a time series of networks that describe how domains have accumulated and how proteins have rearranged their domains through evolution. This is the first time such a network of ‘domain organization’ has been studied as an evolutionary chronology,” Faye Aziz says. “Our survey revealed there is a vast evolving network describing how domains combine with each other in proteins.”

Each link of the network represents a moment when a particular domain was recruited into a protein, typically to perform a new function.

“This fact alone strongly suggests domain recruitment is a powerful force in nature,” Faye Aziz says. The chronology also revealed which domains contributed important protein functions. For example, the researchers were able to trace the origins of domains responsible for environmental sensing as well as secondary metabolites, or toxins used in bacterial and plant defenses.

The analysis showed domains started to combine early in protein evolution, but there were also periods of explosive network growth. For example, the researchers describe a “big bang” of domain combinations 1.5 billion years ago, coinciding with the rise of multicellular organisms and eukaryotes, organisms with membrane-bound nuclei that include humans.

The existence of biological big bangs is not new. Caetano-Anollés’ team previously reported the massive and early origin of metabolism, and they recently found it again when tracking the history of metabolic networks.

The historical record of a big bang describing the evolutionary patchwork of proteins provides new tools to understand protein makeup.

“This could help identify, for example, why structural variations and genomic recombinations occur often in SARS-CoV-2,” Caetano-Anollés says.

He adds that this new way of understanding proteins could help prevent pandemics by dissecting how virus diseases originate. It could also help mitigate disease by improving vaccine design when outbreaks occur.

[phys.org](https://www.phys.org), 30 June 2021

<https://www.phys.org>

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**Enormous Antarctic lake vanishes in 3 days**

2021-07-01

An enormous, ice-covered lake in Antarctica vanished suddenly, and scientists are worried it could happen again.

In this disappearing act, which researchers say occurred during the 2019 winter on the Amery Ice Shelf in East Antarctica, an estimated 21 billion to 26 billion cubic feet (600 million to 750 million cubic meters) of water — roughly twice the volume of San Diego Bay — drained into the ocean.

The scientists who used satellite observations to capture the shocking vanishing act say the lake drained in roughly three days after the ice shelf beneath it gave way. [PLAY SOUND](#)

“We believe the weight of water accumulated in this deep lake opened a fissure in the ice shelf beneath the lake, a process known as hydrofracture, causing the water to drain away to the ocean below,” Roland Warner, a glaciologist at the University of Tasmania and lead author of a new study describing the event, said in a statement. He added that once the water was released, “the flow into the ocean beneath would have been like the flow over Niagara Falls, so it would have been an impressive sight.”

Hydrofracturing (a natural process using the same physical principles as hydraulic fracturing, or fracking, used to extract oil or gas from bedrock) occurs when water — which is denser and, therefore, heavier than ice — rips open gigantic cracks in ice sheets — and then drains into the sea. This leaves behind a gigantic fissure which compromises the structural integrity of the sheet as a whole. As meltwater lakes and streams multiply across the surface of Antarctica, researchers are concerned that growing volumes of surface meltwater could cause more hydrofracturing events, which could cause ice shelves, including the parts which are anchored to the ground, to collapse, thus elevating sea levels above current projections.

“Antarctic surface melting has been projected to double by 2050, raising concerns about the stability of other ice shelves,” the team wrote in their study, which was published June 23 in the journal *Geophysical Research Letters*. “Processes such as hydrofracture and flexure remain understudied, and ice-sheet models do not yet include realistic treatment of these processes.” (Flexure is the flexing of the underside of the ice-shelf by the weight of the meltwater above it, and another potential cause of the break-up of ice-shelves.)

**...an estimated 21 billion to 26 billion cubic feet (600 million to 750 million cubic meters) of water — roughly twice the volume of San Diego Bay — drained into the ocean.**

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Warner and colleagues took aerial measurements of the dramatic outpouring of the lake with observations from NASA's ICESat-2 satellite, which takes readings by bouncing pulses of laser light off a target of interest and measuring the time it takes for the pulses to be reflected. From this time delay, scientists are able to calculate the elevation of a target.

After the deluge, the region surrounding the lake, now free of the water's weight, rose 118 feet (36 meters) from its original position, and there was an enormous fracture — called an ice doline — that carved out an area of about 4.25 square miles (11 square kilometers) along the lake bed. During the summer of 2020, the lake refilled with water in just a few days, with a peak flow of 35 million cubic feet (1 million cubic meters) per day. Whether this water will create new fractures to vanish into, or is already disappearing through the old fracture and out into the ocean, is unclear, according to the researchers.

"It might accumulate meltwater again or drain to the ocean more frequently," Warner said. "It does appear that the fracture reopened briefly during the 2020 summer melt season, so it is certainly a system to watch. This event does raise new questions about how common these deep ice-covered lakes are on ice shelves and how they evolve."

Originally published on Live Science.

[livescience.com](https://www.livescience.com), 1 July 2021

<https://www.livescience.com>

### Scientists spotted an electron-capture supernova for the first time

2021-07-01

A long-predicted type of cosmic explosion has finally burst onto the scene.

Researchers have found convincing evidence for an electron-capture supernova, a stellar explosion ignited when atomic nuclei sop up electrons within a star's core. The phenomenon was first predicted in 1980, but scientists have never been sure that they have seen one. A flare that appeared in the sky in 2018, called supernova 2018zd, matches several expected hallmarks of the blasts, scientists report June 28 in *Nature Astronomy*.

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"These have been theorized for so long, and it's really nice that we've actually seen one now," says astrophysicist Carolyn Doherty of Konkoly Observatory in Budapest, who was not involved with the research.

Electron-capture supernovas result from stars that sit right on the precipice of exploding. Stars with more than about 10 times the sun's mass go supernova after nuclear fusion reactions within the core cease, and the star can no longer support itself against gravity. The core collapses inward and then rebounds, causing the star's outer layers to explode outward (SN: 2/8/17). Smaller stars, with less than about eight solar masses, are able to resist collapse, instead forming a dense object called a white dwarf (SN: 6/30/21). But between about eight and 10 solar masses, there's a poorly understood middle ground for stars. For some stars that fall in that range, scientists have long suspected that electron-capture supernovas should occur.

During this type of explosion, neon and magnesium nuclei within a star's core capture electrons. In this reaction, an electron vanishes as a proton converts to a neutron, and the nucleus morphs into another element. That electron capture spells bad news for the star in its war against gravity because those electrons are helping the star fight collapse.

According to quantum physics, when electrons are packed closely together, they start moving faster. Those zippy electrons exert a pressure that opposes the inward pull of gravity. But if reactions within a star chip away at the number of electrons, that support weakens. If the star's core gives way — boom — that sets off an electron-capture supernova.

But without an observation of such a blast, it remained theoretical. "The big question here was, 'Does this kind of supernova even exist?'" says astrophysicist Daichi Hiramatsu of the University of California, Santa Barbara and Las Cumbres Observatory in Goleta, Calif. Potential electron-capture supernovas have been reported before, but the evidence wasn't definitive.

So Hiramatsu and colleagues created a list of six criteria that an electron-capture supernova should meet. For example, the explosions should be less energetic, and should forge different varieties of chemical elements, than more typical supernovas. Supernova 2018zd checked all the boxes.

A stroke of luck helped the team clinch the case. Most of the time, when scientists spot a supernova, they have little information about the star that produced it — by time they see the explosion, the star has already been blown to bits. But in this case, the star showed up in previous images

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taken by NASA's Hubble Space Telescope and Spitzer Space Telescope. Its properties matched those expected for the type of star that would produce an electron-capture supernova.

"All together, it really is very promising," says astrophysicist Pilar Gil-Pons of Universitat Politècnica de Catalunya in Barcelona. Reading the researchers' results, she says, "I got pretty excited, especially about the identification of the progenitor."

Finding more of these supernovas could help unveil their progenitors, misfit stars in that odd mass middle ground. It could also help scientists better nail down the divide between stars that will and won't explode. And the observations could reveal how often these unusual supernovas occur, an important bit of information for better understanding how supernovas seed the cosmos with chemical elements.

sciencenews.org, 1 July 2021

<https://www.sciencenews.org>

### Landmark study shows one dose of psilocybin induces no neural connections

2021-07-05

An extraordinary new study from a team of scientists at Yale University is reporting the first direct cellular demonstration of a single psilocybin dose inducing neural plasticity in a mammalian brain. The researchers show how the psychedelic prompts rapid growth of neural connections in the frontal cortex of mice and hypothesize this mechanism playing a role in the drug's antidepressant qualities.

Over the last decade psychedelic science has been accelerating at a rate not seen in half a century. MDMA for PTSD and psilocybin for depression are both in late-stage human trials and on the verge of clinical approval, however, we still know very little about how these psychedelic compounds actually generate their therapeutic effects.

Years of good study into depression have given psychedelic researchers clues to where they should be looking. We know depression is associated with synaptic atrophy in the frontal cortex. We also know rapid-acting anti-depressants can improve mood by reversing these synaptic deficits, essentially increasing the volume of neuronal connections in these key brain regions.

So, do psychedelics promote that same kind of neural plasticity?

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This new research, published in the journal *Neuron*, suggests the answer is yes ... at least in mice.

Using chronic two-photon microscopy the researchers imaged the synaptic architecture of the medial frontal cortex in a number of mice. The imaging focused on the number and density of neuronal connections, called dendritic spines. Seven imaging sessions were conducted, beginning before a single dose of psilocybin was administered and stretching up to a month after.

Within 24 hours of that single psychedelic dose the researchers detected increases in dendritic spine size and density. These changes were noted as occurring extremely quickly and also unexpectedly enduring.

One month later a small amount of these new neuronal connections were still present. Alex Kwan, senior author on the study, says it was surprising to see just one dose of psilocybin lead to persistent structural change in the mice brains.

"We not only saw a 10 percent increase in the number of neuronal connections, but also they were on average about 10 percent larger, so the connections were stronger as well," says Kwan. "It was a real surprise to see such enduring changes from just one dose of psilocybin. These new connections may be the structural changes the brain uses to store new experiences."

Alongside these structural changes the researchers note functional and behavioral changes were also detected in the animals following the single psilocybin dose. Increased excitatory neurotransmission in the frontal cortex was measured in the mice and stress-related behaviors reduced. This finding suggests these structural brain changes could play a role in some of the therapeutic benefits seen with psychedelics.

Perhaps most interesting is the study's attempt to dissociate the structural brain changes caused by psilocybin from the drug's acute psychedelic effects. The researchers used a drug called ketanserin to block 5-HT<sub>2</sub> receptors, the pathway by which many believe psychedelic drugs induce their acute "trippy" effects.

Ketanserin effectively stifled head-twitch responses in the animals, which is the primary observational measurement used to track acute psychedelic sensations in mice. But the ketanserin did not block any of the psilocybin-induced brain plasticity changes.

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“The possibility to disrupt psilocybin’s acute behavioral effects without abolishing structural plasticity actions has clear implications for treatment in the clinic,” the researchers hypothesize in the study. “However, it is not yet clear if the results will extrapolate to humans.”

Whether the therapeutic actions of psychedelics can be separated from the acute effects is perhaps one of the biggest unanswered questions in psychedelic science. The researchers do note ketanserin is known to only block around 30 percent of 5-HT<sub>2</sub> receptors in rodents so it is certainly possible the neural plasticity induced by psilocybin is still mediated through that pathway. A lot more work will be necessary to understand exactly what is going on here, and the jury is certainly still out on whether these psychedelic drugs can generate therapeutic effects without generating an acute psychedelic experience.

The research is the first to directly demonstrate these specific structural neural changes induced by psilocybin in a mammal brain. Another very recent study looking at the effects of a single psilocybin dose in a pig brain saw similar signs of psychedelic-induced neural plasticity. That research saw psilocybin increase levels of a key protein known to enhance neuroplasticity.

The new study was published in the journal *Neuron*.

[newatlas.com](https://www.newatlas.com), 5 July 2021

<https://www.newatlas.com>

### CRISPR injected into the blood treats a genetic disease for the first time

2021-06-26

The gene editor CRISPR excels at fixing disease mutations in lab-grown cells. But using CRISPR to treat most people with genetic disorders requires clearing an enormous hurdle: getting the molecular scissors into the body and having it slice DNA in the tissues where it’s needed. Now, in a medical first, researchers have injected a CRISPR drug into the blood of people born with a disease that causes fatal nerve and heart disease and shown that in three of them it nearly shut off production of toxic protein by their livers.

Although it’s too soon to know whether the CRISPR treatment will ease the symptoms of the disease, known as transthyretin amyloidosis, the preliminary data reported today are generating excitement about what

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could be a one-time, lifelong treatment. “These are stunning results,” says gene editing researcher and cardiologist Kiran Musunuru of the University of Pennsylvania, who was not involved in the trial. “It exceeds all my expectations.”

The work also marks a milestone for the race to develop treatments based on messenger RNA (mRNA), the protein-building instructions naturally made by cells. Synthetic mRNAs power two COVID-19 vaccines being given to millions of people to fight the coronavirus pandemic, and many companies are working on other mRNA vaccines and drugs. The new treatment, which includes an mRNA encoding one of CRISPR’s two components, “begins the convergence of the fields of CRISPR and mRNA,” says cardiovascular researcher Kenneth Chien of the Karolinska Institute, a co-founder of Moderna, which makes one of the COVID-19 vaccines and is also developing mRNA drugs.

The CRISPR clinical trial aims to deactivate a mutated gene that causes liver cells to churn out misfolded forms of a protein called transthyretin (TTR), which build up on nerves and the heart and lead to pain, numbness, and heart disease. The resulting condition is relatively rare, and an approved drug, patisiran, can stabilize it. But researchers at veteran biotech Regeneron Pharmaceuticals and startup Intellia Therapeutics saw it as a good proof of principle for the injectable CRISPR treatment they were developing.

Last year, researchers used CRISPR to turn on a fetal form of hemoglobin to correct sickle cell disease or a related disease in several people. The treatment required removing a patient’s diseased blood stem cells, modifying them with CRISPR in a dish, and then infusing them back into the body. A trial testing a direct injection of a virus encoding CRISPR’s components into the eye to treat a condition that causes blindness is also underway. But treating most other diseases means somehow injecting CRISPR’s components, or genetic instructions for them, into the blood and having the therapy target an organ or tissue—a huge challenge, but potentially easier in the liver because it sops up foreign particles.

In the CRISPR trial, four men and two women with transthyretin amyloidosis between ages 46 and 64 were injected with a lipid particle carrying two different RNAs: an mRNA encoding the protein Cas, the CRISPR component that snips DNA, and a guide RNA to direct it to the gene for TTR. After Cas makes its cut, the cell’s DNA repair machinery heals the break, but imperfectly, knocking out the activity of the gene.

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After 28 days, three men given the higher of two doses of the treatment had an 80% to 96% drop in TTR levels, on par or better than the average of 81% with patisiran, the team reports today in *The New England Journal of Medicine*. “The data are extremely encouraging,” says trial leader Julian Gillmore of University College London, who also presented the study today at the online annual meeting of the Peripheral Nerve Society. “It could be potentially the first curative treatment for this hereditary disabling and life-threatening disease,” says neurologist David Adams of the University of Paris-Saclay, who led trials for patisiran. (That drug is a kind of RNA that silences TTR’s production temporarily, meaning it must be injected on a regular basis.)

It may take months for patients receiving the CRISPR treatment to see their symptoms lessen, but they reported few short-term side effects. Problems could surface over time: CRISPR could potentially make cuts in the wrong DNA location (and in nonliver cells), triggering cancer or other problems. But the lipid-encased mRNA approach is potentially safer than using viruses to ferry genetic instruction for encoding an editing protein and guide RNA into cells, a tried-and-true approach others are pursuing for systemic treatments. Those genes can persist in cells, continuing to make the gene editor long after it has done its job. In contrast, “The beauty of mRNA is that it is gone afterwards,” Chien says.

The study paves the way for treating other liver diseases with CRISPR, either by knocking out a gene or—more challenging—modifying it with the help of a DNA template. The latter approach could also be used to turn the liver into a factory for making an enzyme needed elsewhere in body.

Jennifer Doudna of the University of California, Berkeley, who shared a Nobel Prize last year for developing the gene editor CRISPR from a bacterial immune system and co-founded Intellia, sees even bigger prospects. The new work, she says, is “a critical first step in being able to inactivate, repair, or replace any gene that causes disease, anywhere in the body.”

sciencemag.org, 26 June 2021

<https://www.sciencemag.org>

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### These beetles walk on water, upside down, underneath the surface

2021-06-28

Being quite small, insects can have a very different relationship with the water-air interface than larger animals do. Surface tension allows for insects like water striders to skate along the top of still waters, for example. But new research reveals an unusual way to tread along this boundary: from the underside.

A water-dwelling beetle can scuttle upside-down along the underside of the water’s surface, as if the water were a solid pane of glass, researchers report June 28 in *Ethology*. It’s the first detailed documentation of a beetle moving in this manner, which is known only in precious few animal groups.

John Gould, a behavioral biologist at the University of Newcastle in Callaghan, Australia, hadn’t set out to look for beetles one night in the country’s Watagan Mountains, searching instead for tadpoles in ephemeral pools. In one of these pools, he spotted a black object smaller than a pinky nail.

“At first, I just assumed it must have been a bug that had fallen into the water and was swimming across the surface,” Gould recounts, “but then realized the bug was upside-down and below the water’s surface.”

As Gould quickly filmed the scene, the beetle — later identified as a water scavenger beetle (*Hydrophilidae*) — walked under the water’s surface just as it would on a flat, solid surface, periodically resting and changing direction.

Later, Gould mentioned the encounter to his colleague Jose Valdez, a wildlife ecologist at the German Centre for Integrative Biodiversity Research in Leipzig. Valdez thought the observations were interesting, but he’d seen insects walk upright under water before.

“I didn’t fully grasp what he was describing until he showed me the video,” says Valdez. “Then I was floored.”

Searching the scientific literature, the researchers found that some snails could slide along the underside of the water’s surface on a layer of mucus, but little documentation of beetles walking this way existed — just passing mentions in decades-old papers.

**But new research reveals an unusual way to tread along this boundary: from the underside.**



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It's a publication gap that surprised Martin Fikáček, an entomologist at National Sun Yat-sen University in Kaohsiung, Taiwan. The under-surface walking ability is known to aquatic beetle specialists, who exploit the behavior when collecting the beetles. Researchers will unsettle the pond bottom and the beetles float to the surface, where they skitter around upside-down, he explains. But no one had looked closely at the phenomenon.

"It's actually cool that somebody started to think about [the beetles' abilities], because we always see it and we never even thought about it," says Fikáček, who was not involved with this research.

What's still unclear is how the insect physically manages this feat, but the researchers have an idea. Gould's recording of the beetle showed an air bubble trapped along the creature's upturned belly. The team thinks the bubble's buoyancy may be flipping and pinning the beetle to the underside of the water's surface. That allows the insect to put pressure on the water-air boundary with every step, creating what Gould observed as tiny hills of water sprouting from the beetle's feet.

"It would have been really interesting to know which parts of the animals are [water-repellant] and which are not, as well as information on feet anatomy," says Tom Weihmann, a movement physiologist at the University of Cologne in Germany not involved with this study. The beetle might be pushing off against the water like the researchers describe, he says, but this would mean the beetle's feet are attracted to water, contrasting with a water-repellant body.

Gould and Valdez think the beetle might use this water-walking superpower to stay far away from ambush predators that lurk along the bottom of these pools. But this must be sussed out with additional research.

Future research might reveal if the beetles can switch to the opposite side of the water-air interface and leave the water entirely. Additional studies on the physics of the beetle's upside-down water-walking prowess could also inspire advancements in robotics, as has been accomplished with water striders, the team notes (SN: 7/30/15).

The findings highlight how often we ignore or miss the amazing things the smallest animals are doing every day, Gould says. "Describing the natural

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history of the small is just as important as describing the natural history of any large mammal or bird."

sciencenews.org, 28 June 2021

<https://www.sciencenews.org>

### New Zealand to ban most single-use plastics by 2025

2021-06-28

New Zealanders will be farewelling their plastics – bags, ear buds, spoons and straws – as the government attempts to match the country's reality to its "clean green" reputation.

Currently one of the top 10 per-capita producers of landfill waste in the world, New Zealand has announced it will ban a swathe of single-use plastics, including cotton buds, bags, cutlery, plates and bowls, straws and fruit labels.

"Every day, New Zealanders throw away an estimated 159g of plastic waste per person, making us some of the highest waste generators in the world," the environment minister, David Parker, said.

The bans, which will be phased in between 2022 and 2025, would "ensure we live up to our clean, green reputation", he said. Officials estimate that the new policy will remove more than 2bn single-use plastic items from the country's landfills and environment each year.

New Zealand had already banned most single-use plastic bags in 2019, but the changes will include packaging for produce, as well as a range of other items. These steps follow similar bans overseas: outlawing plastic bags is now common around the world, and the UK introduced a ban on plastic straws, stirrers and cotton buds in 2020. The EU has voted for a similar ban to be introduced this year. In some countries, Covid-19 has stalled progress on plastics – a number of US states rolled back their bans on plastic bags and halted new legislation to limit plastic products as the pandemic reached its height. Environmental groups have also reported enormous quantities of "Covid waste" – including plastic gloves, hand sanitiser bottles and surgical masks – are clogging oceans.

The new bans were an important step, but still missed many of the largest producers of plastic waste in New Zealand, said Assoc Prof Terri-Ann Berry, the director of Environmental Solutions Research Centre at Unitec. She said that while drawing public attention to household waste was vital, "it's very easy to forget that some of our more commercial sectors are also big

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plastic users". Construction and demolition, for example, accounted for up to 50% of landfill waste in New Zealand.

The New Zealand government also has coffee cups and wet wipes in its sights, but Parker said work needed to be done to devise alternatives, and the government would announce the next steps for those items next year. The government also announced a fund for businesses to research alternatives to single-use plastics.

[theguardian.com](https://www.theguardian.com), 28 June 2021

<https://www.theguardian.com>

### It's official: China has eliminated malaria

2021-06-25

The World Health Organization (WHO) today is certifying China as free of malaria, after a decades long effort drove an estimated annual toll of 30 million cases in the 1940s, including 300,000 deaths, to zero in 2017. Along the way, China developed new surveillance techniques, medicines, and technologies to break the cycle of transmission between the Anopheles mosquitoes that spread malaria parasites and humans.

Antimalaria efforts started in the 1950s with programs to distribute antimalarial medicines to people at risk, reduce mosquito breeding grounds, and spray insecticides. China launched a program to identify new malaria drugs in the late 1960s. As part of that effort, pharmaceutical chemist Tu Youyou screened traditional Chinese medicine concoctions for compounds active against malaria, eventually isolating artemisinin from sweet wormwood (*Artemisia annua*). Artemisinin became the key compound in the front-line drugs now used against malaria and won Tu a Nobel Prize in Physiology or Medicine in 2015. China was also among the countries pioneering the use of insecticide-treated nets in the 1980s.

Annual case numbers dropped over the years, reaching roughly 5000 annually in the late 1990s. In 2012, the country initiated a push to eliminate malaria with a "1-3-7" strategy, allowing local health facilities 1 day to report a malaria diagnosis, 3 days to investigate the case, and 7 days to implement countermeasures. In recent years, Chinese scientists have developed genetics-based approaches to track drug resistance and to distinguish indigenous cases from imported ones.

"China's ability to think outside the box served the country well in its own response to malaria," Pedro Alonso, director of WHO's Global Malaria Programme, said in a statement.

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After maintaining zero indigenous cases for three consecutive years, China applied for WHO's malaria-free certification, which is being granted following a May inspection mission by the independent Malaria Elimination Certification Panel. One requirement for winning certification is having a program to prevent the reestablishment of malaria, a particular challenge because China shares borders with three countries where the disease is endemic: Myanmar, Thailand, and Laos.

China is the 40th country—and by far the most populous one—to be certified malaria-free. The last three countries awarded the same status were El Salvador, in February, and Algeria and Argentina, both in 2019.

[sciencemag.org](https://www.sciencemag.org), 25 June 2021

<https://www.sciencemag.org>

### Buyer, beware—cyanobacteria toxins in supplements are a serious health risk

2021-06-29

While out shopping, my partner noticed a bottle of shampoo that contained "blue-green algae", a colloquial name for what are actually cyanobacteria, a group of bacteria that growth via photosynthesis. She showed me the shampoo, expecting an amused chuckle or excited grin, because the organisms were the topic of my research. I didn't chuckle or grin: cyanobacteria are notorious for making toxins.

There are a wide variety of different cyanotoxins (a toxin made by cyanobacteria) that can harm humans, wildlife, and livestock. Cyanotoxins can be very potent. Some have toxicities that are comparable to, or in some cases more potent than, cyanide. Symptoms of cyanotoxin intoxication in humans and other mammals include salivation, incontinence, muscle tremors, paralysis, and respiratory failure for the neurotoxins anatoxin and saxitoxin and vomiting, lethargy, abdominal pain, and internal bleeding for the microcystin liver toxins. Many toxin-producing cyanobacteria grow to form large, harmful blooms that can shut down municipal drinking water supplies when their toxins contaminate drinking water.

But it's not just shampoo. Some kombucha also contain cyanobacteria, and cyanobacteria are legally sold as dietary supplements, where they are marketed as "super foods" that are high in vitamins and protein. These "blue-green algae" products are both popular and profitable. The global algae protein market was valued at approximately \$703 million in 2019,

**I didn't chuckle or grin: cyanobacteria are notorious for making toxins.**

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and cyanobacteria protein alone accounted for over 40 percent of this market value.

The ability to produce toxins varies widely between species. Primarily three types of cyanobacteria are sold as dietary supplements or in beauty products: *Arthrospira platensis*, *Arthrospira maxima*, and *Aphanizomenon flos-aquae*. Due to an old naming convention, *Arthrospira* species are typically marketed and sold as "Spirulina." They have a long history as a food source for humans and are generally recognized as nontoxic and safe. Commercial *Arthrospira* is grown in outdoor, industrial ponds designed to selectively maintain near monocultures of *Arthrospira* and avoid the growth of toxic cyanobacteria. However, maintenance problems do occur, and cyanotoxins have been detected in some *Spirulina* products, which indicates that industrial ponds sometimes become contaminated with toxic cyanobacteria species.

In contrast to the *Arthrospira* species used to make *Spirulina* supplements, *Aphanizomenon flos-aquae* (the organism used in the shampoo), produces neurotoxins. *Aphanizomenon* species used in dietary supplements are harvested from the wild, a trait that manufacturers often flaunt in their product descriptions. Since the 1980s, nearly all commercially available *Aphanizomenon flos-aquae* is harvested from Upper Klamath Lake in Oregon, USA, where dense cyanobacteria blooms regularly occur. Because of this, *Aphanizomenon* supplements are sometimes marketed as "Klamath Lake algae."

Since it is wild-harvested, the source material used for *Aphanizomenon* supplements always contains a complex mixture of cyanobacteria species that changes over time and with conditions at the collection site. So, supplement manufacturers have less control over the types of cyanobacteria that are included, which increases the risk of cyanotoxin exposure from taking *Aphanizomenon* supplements.

Although there is inconclusive evidence that the *Aphanizomenon* species that grow in Upper Klamath Lake produce neurotoxins, microcystins have been regularly detected in Upper Klamath Lake, and the state of Oregon has issued toxicity warnings for the area in the past, which supports a legitimate concern for the ingestion of cyanotoxins in Klamath Lake algae supplements. In fact, one study showed that dietary supplements made with Klamath Lake algae can contain concentrations of microcystins up to 60 times higher than safety standards set by Oregon state. Some Klamath Lake algae products have microcystin levels that can surpass safe levels for drinking water set by the World Health Organization by up to 683 percent.

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Klamath Lake algae supplements showed toxic effects in human cells and arthropods, and reports of acute toxicity linked to cyanotoxins in dietary supplements exist for both dogs and humans. And, even low levels of microcystins may increase the risk of developing liver cancer.

However, the true risk of toxicity when using cyanobacteria supplements is hard to estimate because there is a large amount of variation in the amount of cyanotoxins measured from lot to lot, and many supplement manufacturers do not provide suggested doses on their product packaging. Therefore, the amount of cyanotoxin consumed in dietary supplements is likely highly variable between products. Even the low levels of cyanotoxin measured in some contaminated *Spirulina* products may be a concern if product packaging gives consumers the green light to consume as much as desired or when cyanobacteria supplements are consistently used.

Despite the risks to people who take cyanotoxins, current dietary supplement regulations are not adequate to protect consumers. In the United States, dietary ingredients and supplements are regulated by the Dietary Supplement Health and Education Act of 1994, an amendment to the Federal Food, Drug, and Cosmetic (FD&C) Act. Under these rules, products legally marketed before 1994 are "grandfathered" into safe status, which includes *Spirulina* products. This means that no pre-market evaluation or organized clinical dose-escalation studies for *Spirulina*-based supplements are required by US law.

The US Food and Drug Administration (FDA) still requires that dietary supplement manufacturers follow current good manufacturing practices, and reporting of adverse effects is required by law. But these do not prevent cyanotoxin contaminated products from reaching store shelves. The US Pharmacopeial Convention (USP), an official FDA-recognized organization that sets standards for dietary supplements and food ingredients, has safety standards for *Spirulina* products. However, under the FD&C act, compliance with USP is strictly voluntary for dietary supplements – meaning that USP standards are not guaranteed unless the product packaging is labeled as "USP verified". And because USP quality standards only exist for *Spirulina* products, *Aphanizomenon* supplements (which are more likely to contain harmful toxins) have the least regulatory oversight.

Despite all the risks involved in taking cyanobacteria supplements, one would think there must be some genuine health benefits that consumers can weigh against intoxication risks when considering supplementing

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their diets with cyanobacteria. Supplement product labels tout the nutritional and medicinal benefits of both Aphanizomenon and Spirulina, which includes statements such as high protein and antioxidant content, lowering blood pressure and cholesterol, aiding blood sugar control, retaining hair moisture, and improving muscle strength and endurance. Research has little to say about cyanobacteria supplements' effects on hair, but a recent review of 25 clinical trials with cyanobacteria supplements showed some potential in reducing oxidative stress, improving cholesterol content, and reducing blood sugar. However, the same study found that most of the clinical trials reviewed did not meet typical quality standards; studies without double-blinding had to be included in order to have enough literature to review.

The Natural Medicines Comprehensive Database, which is maintained by the US National Institutes of Health, states that there is insufficient evidence to determine the effectiveness of blue-green algae supplements for nutrition and to treat most diseases. In fact, the only condition these supplements are rated "possibly effective" for is high blood pressure. The purported health benefits are simply a marketing gimmick.

In short, there is little or no health and nutritional rewards for consuming cyanobacteria that offset the real and concerning risk of cyanotoxin exposure. Ideally, consumers should avoid ingesting cyanobacteria all together, but consumers interested in a diet that includes cyanobacteria can take precautions to ensure they do so safely. Read the product labels, and avoid all products made with Aphanizomenon or Klamath Lake algae. Stick to purchasing pure Spirulina products from companies that are USP verified and willing to publish data on cyanotoxin content, so that you can make informed decisions about safe dosing.

massivesci.com, 29 June 2021

<https://www.massivesci.com>

### Free divers' heart rates can drop as low as 11 beats per minute

2021-07-02

The world's best free divers can survive brain oxygen levels lower than those found in seals, according to a new study.

Free divers, or those that dive without breathing gear, can hold their breath for more than 4 minutes and descend to ocean depths of more than 328 feet (100 meters). But this endurance feat takes a toll on the

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body's ability to pump oxygen through the blood and to the brain. And if not enough oxygen goes to the brain, free divers are at risk of losing consciousness.

"Before now, understanding the effects on these exceptional divers' brains and cardiovascular systems during such deep dives, and just how far these humans push their bodies, was not possible, as all research was done during simulated dives in the lab," senior author Erika Schagatay, a professor of animal physiology at Mid Sweden University, said in a statement.

PLAY SOUND

"The diver can reach a point where hypoxic (low-oxygen) blackout occurs, and the diver then needs to be rescued," Schagatay said. "One of the main aims of the research is to warn the diver and safety personnel of an imminent blackout."

To understand how this extreme feat affects the human body, Schagatay and her team — along with researchers from the University of St Andrews in Scotland, Carnegie Mellon University in Pennsylvania and the University of Tokyo — adapted a biomedical device, previously developed by the Dutch company Artinis Medical Systems, to withstand extreme ocean pressures.

The biomedical device, which is typically used to measure brain function, fires two different wavelengths of light from LEDs onto the divers' foreheads to measure heart rate and oxygen levels in the blood and in the brain, according to a video about the research. The device worked at depths of at least 351 feet (107 m), according to the statement.

The researchers found that the free divers who reached those depths had brain oxygen levels that dropped to levels lower than those found in seals; some dropped as low as 25%. That's "equivalent to some of the lowest values measured at the top of Mount Everest," Chris McKnight, a research fellow at the University of St Andrews' Sea Mammal Research Unit, said in the statement. Brain oxygen levels are typically around 98%, and if they drop below 50%, a person is almost certain to lose consciousness, according to the statement.

They also found that divers' heart rates dipped as low as 11 beats per minute, McKnight said. As divers descend, their heart rates begin to decrease to help preserve blood-oxygen levels, according to the video.

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The divers' heart rates were as low as those of diving seals, whales and dolphins, according to the statement. These marine creatures are some of the world's best athletes; for instance, elephant seals can hold their breath for 2 hours underwater to hunt for food, according to The Conversation.

"Beyond the exceptional physiological responses that free divers display and the extremes they can tolerate, they may be a very informative physiological group," McKnight said. "Their physiological reactions are so unique and the conditions they're exposed to are not easily replicated, so they offer a unique way of understanding how the body responds to low blood oxygen, low brain oxygenation and severe cardiovascular suppression."

The findings can thus also inform researchers on how to protect the hearts and brains of patients who undergo surgical procedures or experience cardiac events, according to the statement.

The findings were published June 28 in the journal *Philosophical Transactions of the Royal Society B*.

Originally published on Live Science.

[livescience.com](https://www.livescience.com), 2 July 2021

<https://www.livescience.com>

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### Microbes in cow stomachs can help recycle plastic

2021-07-02

Microbes fished from the stomachs of cows can gobble up certain kinds of plastic, including the polyethylene terephthalate (PET) used in soda bottles, food packaging and synthetic fabrics.

Scientists uncovered these microbes in liquid that was drawn from the rumen, the largest compartment of a ruminant's stomach; ruminants include hooved animals like cattle and sheep, which rely on microorganisms to help break down their diet of coarse vegetation. The rumen acts as an incubator for these microbes, which either digest or ferment foods consumed by a cow or other ruminant, according to the University of Minnesota. The researchers suspected that some microbes lurking in a cow's rumen should be capable of digesting polyesters, substances whose component molecules are linked by so-called ester groups.

That's because, due to their herbivorous diets, cows consume a natural polyester produced by plants, called cutin. As a synthetic polyester, PET shares a similar chemical structure to this natural substance. Cutin makes up most of the cuticle, or the waxy outer layer of plant cell walls, and it can be found in abundance in the peels of tomatoes and apples, for example, said corresponding author Doris Ribitsch, a senior scientist at the University of Natural Resources and Life Sciences in Vienna. **PLAY SOUND**

"When fungi or bacteria want to penetrate such fruits, they are producing enzymes that are able to cleave this cutin," or split the chemical bonds within the substance, Ribitsch told Live Science. Specifically, a class of enzymes called cutinases can hydrolyze cutin, meaning they jump-start a chemical reaction in which water molecules break the substance into bits.

Ribitsch and her colleagues have isolated such enzymes from microbes in the past and realized that cows might be a source of similar polyester-munching bugs. "These animals are consuming and degrading a lot of plant material, so it's highly probable that you can find such microbes" living in the stomachs of cows, she said.

And, in fact, in their new study, published Friday (July 2) in the journal *Frontiers in Bioengineering and Biotechnology*, the researchers found that microbes from the cow rumen could degrade not only PET but also two other plastics — polybutylene adipate terephthalate (PBAT), used in compostable plastic bags, and polyethylene furanoate (PEF), made from renewable, plant-derived materials.

**The rumen acts as an incubator for these microbes, which either digest or ferment foods consumed by a cow or other ruminant, according to the University of Minnesota.**

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To assess how well these rumen-borne microbes could eat plastic, the team incubated each type of plastic in rumen liquid for one to three days. They could then measure the byproducts released by the plastics, to determine whether and how extensively the bugs broke down the materials into their component parts. The rumen liquid broke down the PEF most efficiently, but it degraded all three kinds of plastic, the team reported.

The team then sampled DNA from the rumen liquid, to get an idea of which specific microbes might be responsible for the plastic degradation. About 98% of the DNA belonged to the bacteria kingdom, with the most predominant genus being *Pseudomonas*, of which several species have been shown to break down plastics in the past, according to reports in the journal *Applied Microbiology and Biotechnology* and the *Journal of Hazardous Materials*.

Bacteria of the genus *Acinetobacter* also cropped up in high quantities in the liquid, and likewise, several species within the genus have been shown to break down synthetic polyesters, according to a 2017 report in the *Journal of Agricultural and Food Chemistry*.

Looking forward, Ribitsch and her team want to fully characterize the plastic-eating bacteria in rumen liquid and determine which specific enzymes the bacteria use to break down the plastics. If they identify enzymes that could potentially be useful for recycling, they can then genetically engineer microbes that produce those enzymes in large quantities, without the need to collect said microbes directly from cow stomachs. In this way, enzymes can be produced easily and inexpensively, for use at industrial scales, Ribitsch said.

In that vein, Ribitsch and her team have already patented a recycling method in which textile materials get exposed to various enzymes in sequence; the team identified these enzymes in previous work. The first batch of enzymes eats away at cloth fibers in the material, while the next batch of enzymes goes after specific polyesters. This works because each enzyme targets very specific chemical structures and therefore won't break down just any material it encounters. In this way, textiles that contain multiple materials can be recycled without first being separated into their component parts, Ribitsch explained.

Per the new study, cow rumens may represent another environment in which to discover these sorts of helpful enzymes, but such enzymes crop up in many places in nature, said David Levin, a molecular biologist and

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biotechnologist in the University of Manitoba Department of Biosystems Engineering who was not involved in the research.

For instance, the first bacterium found to be capable of consuming PET was *Ideonella sakaiensis*, a species involved in sake fermentation, Levin said. Certain marine organisms secrete cutinases that can break down plastic, as do various fungi that infect land plants, he noted.

Thus far, scientists have had luck finding plastic-eating enzymes that break down PET and biodegradable plastics like PBAT and PEF, but now, the real challenge lies in finding enzymes to break down more troublesome plastic products, Levin said.

For example, plastics like polyethylene and polypropylene are largely made up of strong bonds between carbon atoms, and this structure limits the ability of enzymes to grab hold of the molecules and jump-start hydrolysis, Ribitsch said. So while scientists have already discovered, characterized and commercialized enzymes to degrade PET, researchers are still on the hunt for microbes that can handle polyethylene and polypropylene, Levin said. Levin and his lab have identified a few promising candidates on this front, but they are still figuring out how to maximize the bugs' plastic-eating powers.

Ribitsch said her team also has an eye out for microbes that can consume polyethylene and wonders if the bugs might be lurking in the stomachs of cows. "Maybe we can find, in such huge communities, like in the rumen liquid, enzymes that can also degrade polypropylene and polyethylene," she said.

Originally published on Live Science.

[livescience.com](https://www.livescience.com), 2 July 2021

<https://www.livescience.com>

### Drinking this kind of water increases your Parkinson's risk, studies show

2021-07-03

Approximately one one million people in the U.S. today have been diagnosed with Parkinson's Disease (PD). A progressive neurological disorder, PD often starts with minor tremors and leads to shaking, stiffness, and poor motor coordination, making it difficult for patients to walk, talk, and balance.

**A growing body of research suggests that there is a correlation between drinking well water and developing Parkinson's Disease later in life.**

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Do carbonated drinks affect my dental health?

Symptoms from Parkinson's arise when neurons in the brain begin to break down or die, impeding the movement of dopamine from your brain to your muscles. Beyond that, the root cause of Parkinson's is unknown, though the Mayo Clinic says that certain genetic and environmental factors appear to play a role. In fact, recent research suggests that there's one thing you may do every day that can lead to a heightened risk of developing Parkinson's Disease: drinking a certain type of water. Read on to learn which kind of water is associated with higher rates of Parkinson's Disease, and how this may affect your own risk level.

Drinking well water is linked with a higher likelihood of developing Parkinson's.

A growing body of research suggests that there is a correlation between drinking well water and developing Parkinson's Disease later in life. One particular study, conducted by a team at UCLA and published in the journal *Environmental Health Perspectives*, found that those who consume well water are statistically more likely to develop PD. After reviewing the medical records and personal histories of 700 people living in California's farm belt between 1974 and 1999, they determined that those who ultimately developed PD had consumed private well water on average 4.3 years longer than those who did not.

A lack of regulation could be to blame.

Experts believe that the link between well water and Parkinson's could be the result of well water being more likely to be contaminated with metals, pesticides, herbicides, and other pollutants than filtered municipal water. "Unlike municipal water supplies, private wells are largely unregulated and are not monitored for contaminants. Many are dug at shallow depths of less than 20 yards, and some of the crop chemicals used to kill pests and weeds can seep into groundwater," explains *Scientific American*.

Broader environmental factors may also be to blame.

While the research seems to support an association between well water and an increased risk of PD, the American Parkinson Disease Foundation (APDA) points out that the interrelated nature of several environmental factors make it difficult to single out any one factor as solely responsible.

Those who drink private well water are more likely to live on a farm, be exposed to pesticides through other means, live in proximity to farm animals, and live in rural areas. "In the end, epidemiologic data supports

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the assertion that each of these elements increases the risk of PD," the APDA explains.

Certain chemicals lead to more dangerous contamination.

Those who consumed well water in close proximity to certain pesticides were found to be at a higher risk than others. In particular, the UCLA study found that people drinking well water within 500 meters of fields sprayed with pesticides had a 66 percent increased risk of later developing PD. Those drinking well water near land treated with the insecticides propargite or chlorpyrifos had a 90 percent higher risk. This translates into a nearly doubled risk of someday developing Parkinson's.

"The chemical with the most data linking it to an increased PD risk is paraquat," says the APDA, referring to a chemical herbicide used to kill weeds. Exposure to paraquat is "associated with a 2-3 fold increased PD risk over the general population," the organization warns.

If you regularly consume well water, especially in areas being sprayed with chemical pesticides or herbicides, be sure to have your water filtered and regularly tested.

[bestlifeonline.com](https://www.bestlifeonline.com), 3 July 2021

<https://www.bestfriendonline.com>

### Probiotic 'yeast robots' may one day treat IBD

2021-07-04

Inside the human gut, a whole host of bacteria, fungi, and other microbes maintain a delicate balance, with a far-reaching influence on our health. Scientists have shown that certain chronic conditions, such as IBD, are linked with this so-called dysbiosis.

But what if we had a supplement that could sense disturbances to the microbiome and restore balance to treat chronic disease?

Now, scientists from Brigham and Women's Hospital in Boston, MA, have engineered a "designer" probiotic that they say could do just that.

The genetically engineered yeast can respond to inflammation and successfully relieve IBD symptoms in mice, according to the new study, published in *Nature Medicine* Trusted Source.

IBD and the gut microbiome

**But what if we had a supplement that could sense disturbances to the microbiome and restore balance to treat chronic disease?**

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IBD is an umbrella term Trusted Source for a number of conditions that are characterized by persistent inflammation of the gastrointestinal tract. The two most common forms of IBD are Crohn's disease and ulcerative colitis.

In 2015, approximately 3 million Trusted Source adults in the United States had an IBD diagnosis, according to the Centers for Disease Control and Prevention (CDC).

Common symptoms include diarrhea, abdominal pain, bloody stools, fatigue, and unexplained weight loss.

Previous studies Trusted Source have found that people with IBD have an unbalanced gut microbiome, with lower overall diversity and more of the bacterial species that drive inflammation. Scientists believe probiotics could help restore this balance and reduce inflammation.

However, many probiotics currently on the market have been optimized through evolution in a healthy gut.

In this new study, the researchers argue that to treat IBD, a probiotic would need to serve many functions, including halting inflammation, reversing tissue damage, and rebalancing gut bacteria.

### Beer belly

Dr. Francisco Quintana, an investigator at the Brigham and Women's Hospital, and colleagues wanted to design a probiotic that could address all these needs.

"What we wanted to [...] do was to use a platform that would allow us to manipulate the new response in a very specific way, when and where needed," Dr. Quintana told Medical News Today. "And that led us not to any probiotic but actually to yeast."

Affectionately termed "yeast robots" by the scientists, the probiotics are developed from *Saccharomyces cerevisiae*, a species of yeast that is also used to make beer and wine and in baking.

It is not commonly used as a probiotic but lives naturally in the human gut as part of a healthy microbiome.

Dr. Quintana and his team used CRISPR-Cas9, a type of gene-editing technology, to introduce a gene that is activated by inflammation in the gut.

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When the yeast senses inflammation, it secretes an enzyme that degrades inflammatory molecules called extracellular adenosine triphosphate (eATP), thereby reducing inflammation.

The engineered yeast produces different amounts of the enzyme, depending on how much of the inflammatory signals are present. In this way, the yeast probiotic is "self-tuning" and can provide a highly localized response to specific sites of inflammation within the gut.

### Mouse models

The researchers tested the probiotics in mice with various types of IBD. After orally administering the engineered yeast, they found that the mice had lower expression of genes that promote inflammation in the colon.

This translated into suppressed intestinal inflammation and reduced fibrosis — where the gut lining becomes scarred and thickened, which can cause the intestines to become blocked.

In some cases, the engineered probiotics rivaled the effectiveness of drugs similar to those used to treat people with IBD, such as tumor necrosis factor (TNF)-blocking antibodies Trusted Source.

"In some models, they perform literally as well," Dr. Quintana told MNT. "And in some of the models we use, the yeast actually outperformed, for example, TNF-blocking antibodies."

Before the designer probiotic can be used in humans, however, Dr. Quintana and the team will need to conduct further safety studies and engage in large-scale clinical trials. They also plan to refine the yeast further to focus on speeding up tissue repair.

Dr. Quintana's ambitions also stretch beyond the gut.

"We're using the gut as a window to really target inflammation in many other tissues," he said. Dr. Quintana's lab has previously explored the role of inflammation in the brain in multiple sclerosis and plans to explore how these genetically engineered yeast robots could offer new possibilities for treatment.

"If we think in terms of software and hardware, these are hardware, where you can incorporate a code, which is a piece of software. That will



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allow you to target not only different aspects of IBD but also different inflammatory conditions.”

medicalnewstoday.com, 4 July 2021

<https://www.medicalnewstoday.com>

### Where did watermelons come from?

2021-07-05

The iconic green and red watermelon is a sweet, refreshing summer staple. But it wasn't always so sugary or vibrantly colored. So what did watermelons originally taste and look like, and from where did they originate?

The thirst-quenching fruit isn't from the Fertile Crescent of ancient Mesopotamia, as so many other domesticated crops are, research shows. Susanne Renner, a botanist at Ludwig Maximilian University of Munich in Germany, and her colleagues carried out comprehensive genetic sequencing of the domesticated watermelon (*Citrullus lanatus*) — the kind you might find on supermarket shelves — along with six wild watermelon species.

“We found the modern genomes of the domesticated watermelon are more closely related to the Sudanese wild type than any other that we analyzed,” she told Live Science. The Sudanese wild watermelon has some notable differences to the domesticated version. “The flesh is white and not very sweet, and it's mainly used as animal feed,” Renner said.

Nevertheless, the genetic similarity between the two species led the researchers to conclude that the Sudanese fruit is probably a precursor to the red and sweet domesticated watermelon, according to the June 2021 study published in the journal the Proceedings of the National Academy of Sciences.

It's likely that ancient farmers cultivated non-bitter variants of the wild watermelon and consequently increased its sweetness over many generations through the domestication process. The red color is probably also thanks to artificial selection, in which farmers likely favored and selectively bred red fruit. When this happened and which civilization is responsible for it is slightly less clear, but Renner attempted to answer this question. She thinks the geographical location of the close wild type relative in Sudan is probably not a coincidence.

**So what did watermelons originally taste and look like, and from where did they originate?**

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We already knew that the ancient Egyptian king Tutankhamun was buried with watermelon seeds 3,300 years ago, but that isn't sufficient proof of a domesticated, sweet watermelon. “The seeds may have been used as savory snacks from a wild watermelon,” Renner said.

But then, she found an image of a watermelon-like fruit on an ancient Egyptian tomb painting, thought to be more than 4,300 years old. “The image was originally published back in 1912, but nobody had interpreted it as a watermelon before,” Renner said. In a separate tomb, “another image shows the watermelon cut up on a tray alongside other sweet fruits, such as grapes.” This realization, coupled with Renner's genetic findings, begin to paint a picture of ancient Egyptians enjoying domesticated and sweet watermelons. That, in turn, suggests that the watermelon was most likely domesticated around that time either in Egypt or within trading distance of the ancient empire.

“The ancient Nubians who lived in modern-day Sudan are often overlooked in favor of the Egyptians,” Renner said. “It could have been the ancient Nubians who domesticated it and traded it with the ancient Egyptians or it could have been the Egyptians, but what my research suggests is that it was somewhere in this region that the watermelon was first domesticated, and the ancient Egyptians were eating them.”

Historically speaking, that's a very significant finding, said Hanno Schaefer, a professor of plant biodiversity at the Technical University of Munich. “It's becoming clearer that we've massively neglected the North African region. We've focused too much on the Fertile Crescent where grains and pulses [edible legume seeds] seem to have originated, but we need to invest more resources into studying the agriculture of North Africa and add those findings to the archaeological evidence,” Schaefer told Live Science.

Studying the wild relatives of domesticated crops has an application beyond historical curiosity; it could prove helpful for modern-day breeders and farmers. “There are many traits of wild populations that would be useful in watermelon breeding — they're less susceptible to mold, viruses and insects than domesticated species,” Renner said. Knowing more about wild watermelon DNA could help breeders take those beneficial gene variants and implant them into the modern crop without compromising the watermelon's sweet taste and red hue, which has taken so long to acquire through selective breeding.

This could potentially enable watermelon farming to weather the future challenges that climate change will bring, such as drought and higher

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temperatures, Schaefer said. "I'm sure the industry will be interested in studies tackling the genetics of watermelon."

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[livescience.com](https://www.livescience.com), 5 July 2021

<https://www.livescience.com>

### **Ketamine and flickering light bring youthful plasticity to older brains**

2021-07-06

The connections between the brain's neurons are more malleable during the developmental stages of life, when the youthful organ continually reshapes the synapses between cells as we encounter new experiences, learn new skills and develop new habits. A great deal of research centers on restoring this youthful plasticity to older brains as a way of tackling some effects of aging, and a team in Austria has now identified a pair of promising new approaches, which involve specific flickers of light and high dosages of ketamine.

Efforts to equip older brains with the plasticity of juvenile ones are motivated by the hope that such a feat could open up new treatments for all kinds of neurological conditions. We've seen advances in this area involving molecular switches that boost memory and assist recovery from brain injury, neuron transplants that improve motor function, and gene therapies that restore visual capabilities in older mice.

In this new work, scientists at Austria's Institute of Science and Technology (IST) have focused on a structure that plays an important role in brain plasticity known as the perineuronal net, which we've also seen implicated in diabetes breakthroughs. This net encases some neurons in the brain, locking in the existing connections between them and preventing new ones from forming.

In this way, the perineuronal net is key to the storage of childhood memories and habits, but by the same token, stops a mature brain from being as adaptable as a youthful one. The scientists sought to explore whether the net could be temporarily dismantled, making neurons more receptive to new experiences and allow new synapses, or connections, to form.

Their discovery begins with mice that had been anesthetized with ketamine, which the scientists found caused cells in their brains called

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microglia to become highly reactive. In this state, microglia have the capacity to eat up synapses and neurons, something seen in late-stage Alzheimer's, but the scientists saw no evidence of this taking place.

"The strong response of the microglia upon ketamine anesthesia surprised us," explains Alessandro Venturino, lead author of the study. "But we did not see any synapses or dead neurons vanishing. So, we were puzzled, what the microglia were actually eating."

To their great surprise, the scientists found that the microglia were actually gobbling up the perineuronal net.

"Alessandro came to my office and told me that the perineuronal net was gone. I could not believe it," says leader of the research group Sandra Siegert. "After just three treatments, we could see a considerable loss in the perineuronal net, which lasted for seven days before being rebuilt."

The prospect of using non-invasive ketamine treatment to induce temporary changes to the perineuronal net is an exciting one, as techniques that remove the net have been demonstrated before, but with long-lasting effects and only through highly invasive measures.

But through their experiments, the scientists may have uncovered another, even less invasive approach, in flickering light.

This type of research looks to leverage the way neurons communicate, by passing coordinated electric impulses between one another. By using external stimuli, such as a light flickering at a specific frequency, the idea is that these signals can be manipulated for better health outcomes. One application with lots of potential concerns Alzheimer's, with one 2019 study showing how a light flickering at 40 Hz can boost microglia and help clear away toxic proteins associated with the disease.

Subjecting mice to light flickering at 40 Hz in the experiments was found to have no effect on the perineuronal net. But when the rodents were placed in boxes with a light flickering at 60 Hz, the scientists found it induced a similar effect on the structure to the ketamine treatments.

"It had been previously shown that light flickering 40 times a second – at 40 hertz – can promote microglia to remove plaques in Alzheimer disease," says Venturino. "But it did not remove the perineuronal net. This fine-tuning between distinct brainwaves and the microglia action is the most fascinating and might be a new way of thinking about brainwaves."

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These discoveries open up two promising new avenues in potentially restoring youthful plasticity in human brains. The researchers note that there is plenty still to learn about how these techniques work, but imagine they could one day be used to treat conditions like lazy eye, caused by an unbalanced visual input during childhood, or possibly overwrite painful memories and experiences to treat post-traumatic stress disorder (PTSD). At the same time, they are very aware of the risks such an approach could pose.

“But we are very cautious because in this formative window also something traumatic could happen,” Siegert says. “It is probably also not a good idea to blast yourself with flickering light.”

The research was published in the journal Cell Reports.

Source: Institute of Science and Technology Austria

newsatlas.com, 6 July 2021

<https://www.newsatlas.com>

### How COVID-19 vaccines were made so quickly without cutting corners

2021-06-29

Six months after the first COVID-19 shots started going into arms in the United States, the pace of vaccination has slowed. That’s prompted White House officials to scale back their goal of getting at least one dose to 70 percent of all U.S. adults by July 4; they’re now aiming for 70 percent of those 27 and older.

Even so, more than 1 in 5 Americans say they won’t get vaccinated, according to a recent poll by the American Psychiatric Association. Among the reasons that often pop up are worries that the vaccines were developed too fast: Normally, drug research takes years or even decades from idea to reality. The first vaccines to combat COVID-19 were developed, tested and given emergency use authorization in 11 months.

Driven by a global urgency and underpinned by decades of prior work on vaccine technology, vaccine developers found a way to chop not just days or months, but years off the timeline (SN: 2/21/20). What was jettisoned was not the science, or the safety tests, but rather the wait time baked into the development process — waiting for results and waiting for regulatory approvals (SN: 7/10/20).

**Even so, more than 1 in 5 Americans say they won’t get vaccinated, according to a recent poll by the American Psychiatric Association.**

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By comparing the new vaccines with earlier drugs that have used the same tech under more traditional research timelines, it is possible to calculate approximately how much time got chopped off the development process once shots were ready to go into arms: roughly four years. Here’s how.

Unlocking the coronavirus’ secrets

To back up a bit first, designing the vaccines began far earlier than the jabs-in-arms stage. It began with deciphering the exact genetic makeup of SARS-CoV-2, the virus that causes COVID-19 (SN: 12/11/20). By early January 2020, that genetic blueprint was in hand and the first vaccines to test were ready just a few weeks later.

For some perspective, researchers first deciphered, or sequenced, the entire human genome over a span of almost 13 years, starting in 1990 and wrapping up in 2003 (SN: 1/17/03). Because of advances in computers, the same task now can take only hours.

Most crucially, researchers now had the genetic instructions for making the spike proteins that the virus uses to break into cells — a key ingredient for making the vaccines. Jutting out from the virus’ surface, these spike proteins make an easy target for the immune system to recognize. Researchers knew to zero in on those proteins thanks to decades of work studying coronaviruses, including two that have caused other outbreaks of human diseases — SARS and MERS. That work also identified the best form of the protein to use: a stable form just before the virus fuses with a cell it’s about to infect.

Finding a delivery system

Those instructions could then be fed directly into pre-made delivery vehicles that carry the genetic code to cells to induce an immune response. Scientists had already built these rapid, genetically based templates largely because of the ongoing battle against HIV, says Tom Denny, Chief Operating Officer of the Duke Human Vaccine Institute in Durham, N.C.

“In the last 10 to 15 years, there’ve been major teams around the world ... trying to understand what needed to occur to make a protective HIV vaccine,” Denny says. Those efforts have “helped us in our battle with this current pandemic.”

These vehicles are like the Potato Head toys of the vaccine development world: Instead of swapping in different facial features, information specific to each virus gets plugged in.

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Denny calls it “plug-and-play” vaccine manufacturing. Decades of trying to attack HIV has created a library of safe weapons to use quickly against any new would-be viral marauders. “We got lucky,” Denny says, that the developed platforms have worked so well for this new deadly virus.

One of the templates directly carries a nonfunctional, partial strand of viral mRNA to cells in the body, delivering instructions for those cells to create copies of the protein that the immune system recognizes as foreign. That’s what’s used in the Pfizer-BioNTech and Moderna shots.

The mRNA for the coronavirus’ spike proteins gets packaged inside tiny bubbles of fat called lipid nanoparticles. These tiny fat bubbles have been around for decades and safely used for dozens of other drugs, some approved, others still in the pipeline. So all that needed to be changed to target SARS-CoV-2 were the directions nestled inside.

The contents of the fat bubbles are known as their “payload,” says Vicki Stronge (SN: 11/20/20). She’s the director of product management at Precision NanoSystems in Vancouver, which manufactures equipment and compounds for the development of lipid nanoparticles. She explains why those fat bubbles are so crucial: If the mRNA is injected alone outside a bubble, it breaks down quickly, degrading into harmless biological raw bits and pieces that get recycled by our bodies.

### Benefiting from past research

Two key therapies — one still in the works and one approved — paved the way for COVID-19 vaccine developers to hit the ground running with RNA-based templates.

One therapy, made by Germany-based CureVac, is the first vaccine to reach human trials that was developed using mRNA to fight an infectious disease. It targets the rabies virus and was injected into human volunteers starting in 2013. Decades earlier, in 1971, researchers developed the first syringefuls that they thought were safe for humans, which they initially tested by injecting themselves. The first version of the mRNA-based rabies vaccine prompted only a weak immune system response but did show that the technology was safe. A newer version of this rabies vaccine is starting to show promising results in clinical trials. (CureVac is also developing an mRNA COVID-19 vaccine, although early results have been disappointing.)

The other therapy is patisiran, an RNA-based drug for a rare but often fatal heredity disease in which amyloid proteins build up in nerves and some

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organs. It uses the same design based on lipid nanoparticles as the mRNA-based COVID-19 vaccines, just with a different payload inside.

Years of data from monitoring patients who had been injected with these RNA fragments wrapped in lipid nanoparticles shows they’re safe, says Sascha Tuchman, a hematologist-oncologist at the University of North Carolina at Chapel Hill who oversaw a site for the Phase III patisiran trials. Patients who receive a dose of patisiran have a lower risk of side effects than those who got injections with placebo saline. And when it comes to long-term negative consequences from RNA and lipid nanoparticles, Tuchman says, “we haven’t seen anything additional in terms of the safety that would indicate that there is some reason to be concerned.”

Six years after the first shots began being tested, the FDA approved patisiran, a little faster than standard pace for new treatments. That makes it a good comparison to show where the COVID-19 vaccines were able to cut time, not counting the decades of research of development that got us to this point. So let’s start the clock.

### Recruiting volunteers

After the first syringefuls of prospective COVID-19 vaccine emerged from the “plug-and-play” mRNA labs, years were removed from the timeline by cutting out the long stretches of pure waiting that are built into most human testing. Driven by the urgency of the pandemic, nearly half a million people in America alone had offered up their deltoids for the cause through the COVID-19 Prevention Network in a matter of months, in many cases even before the first public inklings of success, according to the American Medical Association.

For instance, it took just under 16 weeks to recruit and enroll more than 43,000 volunteers for the final phases of testing Pfizer’s vaccine. When volunteer recruitment began for clinical trials of the rabies mRNA vaccine in 2013, it took 813 days to get 101 participants enrolled. Based on this comparison, that’s roughly 730 days — nearly two years — saved in recruiting alone.

### Getting fast results

Another, more dismal factor contributed to the scientific speed: How fast the virus spread.

Scientists can begin to calculate a vaccine’s efficacy when a sufficient number of people in the group that got a placebo rather than a vaccine have gotten infected naturally (SN: 10/4/20). If an outbreak peters

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out, it takes longer to reach that threshold. That's true too if a virus naturally spreads more slowly — say a virus like HIV, herpes or human papillomavirus, or HPV, which are transmitted primarily through sex. In contrast, just breathing or talking can spread SARS-CoV-2 — and everybody does that (SN: 4/2/20).

Loosely comparing vaccine trials for COVID-19 with HPV vaccine trials offer clues to just how many days may have been lopped off the COVID-19 timeline because of the new virus's astronomical rate of spread. The HPV trials took about 529 days, or 1.4 years, to reach a point at which efficacy could be calculated, when the placebo group got to an infection rate of 3.8 percent.

The Pfizer Phase II/III coronavirus trial, in contrast, got initial efficacy results for the first of its two doses in just 105 days, when it hit a nearly 2.4 percent infection rate in the placebo group. That's 424 days faster than HPV. Why? Because just months into the pandemic, SARS-CoV-2 was infecting hundreds of thousands of people per day globally.

## Jumping the line

There was also waiting time recouped from the U.S. Food and Drug Administration's review process. Typically, it takes the FDA 10 months to review a new drug.

However, with the COVID-19 death toll rising, the FDA rushed all coronavirus vaccines to the front of the review lines. The Pfizer vaccine got reviewed and authorized for emergency use only 21 days after submission and the Moderna vaccine in just 19 days (SN: 12/11/20; SN: 12/18/20). Compared with a more typical 10-month wait time, that's about another 283 days saved.

In total, that's 1,437 days, or 3.9 years, cut off the normal timeline for a new vaccine. And that doesn't include other time savings, such as putting the ethics reviews at the front of the line. Add that saved time to the 11 months it actually took to get the first COVID-19 vaccines and it would add up to nearly five years — remarkably close to the six years needed to test and approve patisiran.

In a final jolt of speed, some pharmaceutical companies, bolstered by big vaccine contracts and research cash from the U.S. government's Operation Warp Speed, were also churning out doses during clinical trials in the hopes that the vaccines would work. Once the companies had emergency use authorization in hand, they were ready to ship doses immediately.

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Decades of previous work combined with a fast-moving virus, a public willingness to help and elimination of wait times drove the rapid development of COVID-19 vaccines. No safety steps were skipped, says Stanley Plotkin, emeritus professor of pediatrics at the University of Pennsylvania, who is perhaps best known for his work developing the rubella vaccine.

The rapid creation of the COVID-19 vaccines, Plotkin says, are "a sea change in how to develop vaccines." They are an example of what scientists can do when unfettered from waiting.

sciencemag.org, 29 June 2021

<https://www.sciencenews.org>

### Pfizer and Moderna vaccines may provide years of protection from COVID-19

2021-07-01

The Pfizer-BioNTech and Moderna COVID-19 vaccines will likely provide protection against the coronavirus for years if it doesn't evolve significantly, a small new study suggests.

As a massive vaccination effort continues to play out across the globe, there is still a question about how protective COVID-19 vaccines will be in the long term and whether booster shots will be necessary. Some vaccines for other viruses, such as influenza, provide only fleeting protection and need to be renewed every year, but others — such as the MMR vaccine for measles, mumps and rubella — confer lifelong protection.

The level of protection depends on how much and how quickly the virus evolves, as well as on how robust different types of vaccines are in spurring a lasting immune response. The Pfizer-BioNTech and Moderna vaccines both use a relatively novel platform known as messenger RNA (mRNA) to train the immune system to fight SARS-CoV-2, the virus that causes COVID-19, Live Science previously reported.

While mRNA vaccines have greatly exceeded experts' expectations and have shown high efficacy in protecting people from SARS-CoV-2, including its currently circulating variants, how long this protection will last hasn't been clear.

To figure this out, a group of researchers recruited 41 participants who received two doses of the Pfizer-BioNTech vaccine; eight had previously been infected with SARS-CoV-2. The researchers collected blood samples

**The level of protection depends on how much and how quickly the virus evolves, as well as on how robust different types of vaccines are in spurring a lasting immune response.**

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at the start of the study and then three, four, five, seven and 15 weeks after the participants received their first dose of the vaccine.

Consistent with previous studies, the researchers found that the mRNA vaccine induced strong antibody responses and that those responses were even stronger in people who had recovered from a mild SARS-CoV-2 infection prior to being vaccinated.

The team also collected lymph node samples across this same time span from 14 people, none of whom had previously been infected with SARS-CoV-2. In response to infections and vaccinations, fleeting molecular structures known as “germinal centers” form inside the lymph nodes, the glands that hold immune system cells and typically swell in response to an infection.

In people who are infected with SARS-CoV-2, these structures form in the lymph nodes of the lungs, which are difficult to access, whereas vaccines typically spur their production in the armpits, which is more easily accessible.

“You can think of them as our boot camps for the immune cells,” said senior author Ali Ellebedy, an immunologist at the Washington University School of Medicine in St. Louis. The structures train a type of immune cell known as B cells over weeks and months to bind better to a pathogen — in this case, SARS-CoV-2.

The process creates highly trained immune cells, some of which are memory cells that will remember the virus in the long-term.

Not much is known about how long these “boot camps” last inside the lymph nodes in humans; animal studies have shown that they typically last only a few weeks, Ellebedy said.

But in the new study, Ellebedy and his team found something surprising: In most of the participants who received the vaccine, their germinal centers continued to be active, training these robust immune cells for at least 15 weeks after the first dose.

‘Very promising’ protection

Because this germinal-center response lasted for months, it likely produced many memory cells that will last for years; and some of these memory cells will likely establish themselves inside bone marrow and produce lifelong antibodies, Ellebedy told Live Science. That’s “very

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promising” but doesn’t necessarily mean people won’t need booster shots, he said.

Rather, the need for booster shots will depend on how much the virus evolves and whether the cells produced by the germinal centers are robust enough to handle significantly different variants, he added. In addition, not everyone generates the same robust immune response; some people, such as those with suppressed immune systems, will likely need booster shots, he said.

“This study, like others before it, confirms that the vaccines are eliciting the appropriate reaction from the immune system and that durable immunity is being created,” said Dr. Amesh Adalja, an infectious-diseases specialist and a senior scholar at the Johns Hopkins Center for Health Security in Baltimore.

Adalja, who was not involved in the new study, agrees that it’s too soon to discuss whether we will need booster shots. “If a large proportion of the fully vaccinated are contracting breakthrough infections that land them in the hospital, that is the threshold for booster vaccinations,” he told Live Science in an email.

Still, this is the first study to provide direct evidence that the germinal-center response is persistent in humans after vaccination. Although the authors didn’t look at people who had received the Moderna vaccine, they think the response will likely be similar, because it’s also an mRNA vaccine that showed a comparable efficacy, Ellebedy said. However, more research will be needed to see the duration of the germinal-center response from the Johnson & Johnson vaccine, because it uses a different platform (rather than mRNA), he said.

Now, Ellebedy and his team hope to continue monitoring these cells to see whether they migrate and settle permanently in bone marrow. In other words, it’s still unclear whether these immune cells will “become our life partners, basically helping us for the rest of our lives” or if we will eventually need booster vaccines to make some better fighters.

The findings were published online June 28 in the journal Nature.

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[livescience.com](https://livescience.com), 1 July 2021

<https://www.livescience.com>

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### 6 weird animals that evolution came up with

2021-06-30

#### 1. Invisible frog

Most creatures hide their internal organs underneath multiple protective layers of skin, tissue and bone. But what if these layers were see-through?

Looking at a glass frog from above, you may not notice anything out of the ordinary. But if you were to flip it over, you would spy a tiny, fast-beating heart, a long, red vein, and a section of squirming intestines breaking down food. These amphibians have evolved to have extremely thin, translucent skin.

So why did these frogs evolve to be see-through? While these frogs' thin skin puts their entire internal anatomy on full display, when light shines on the frogs from above their silhouette becomes muddled to predators, according to a study published June 9 in the journal *Proceedings of the National Academy of Sciences*.

These frogs live in the rainforests of Central and South America and spend much of their time perched on leaves. Because the frogs are surrounded by lush greenery, their vibrant-green topcoats are ideal for camouflage. Meanwhile, their more transparent legs blur the outlines of their bodies, making it tough for predators to recognize the frogs' shape, the study found.

#### 2. Wasp-fig relationship

Unlikely relationships are often formed in the wild. For instance, fig wasps have found an unusual home inside figs. The fig "fruit" is actually a bundle of tiny flowers, called an inflorescence, which relies on fig wasps for pollination. In turn, the fleshy inflorescence provides a comfy and safe home for the wasps during their very short lives.

When female fig wasps hatch into the world, they are primed to "sniff out" receptive fig trees, or those whose flowers are ready for pollination, according to The Netherlands Entomological Society. Instinctively, the wasps search out the particular aroma emitted by female fig flowers, according to the U.S. Forest Service. Once they find a fig-in-need, the wasps dig their way into the soft, sweet flower through an opening at the end of the fig "fruit." The hole is so small that many wasps lose their wings and parts of their antennas. Once inside the fig, the female wasps are protected and out of sight, and they are able to lay their eggs. According

### So why did these frogs evolve to be see-through?

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to the *Journal of Nematology*, the wasps will not see the outside world ever again. The females die just 24 hours after laying their eggs.

When the fig wasps hatch, the male hatchlings mate with the females, before digging escape routes out of the fig for the females. The male wasps spend their entire lives in the fig and die shortly after producing the tunnels.

This odd behavior has kept this wasp species alive for over 60 million years, according to an article published in 2005 in the journal *Proceedings of the Royal Society B*. Figs have these insects to thank for their continued existence, as their movement from one fig to another spreads their pollen.

#### 3. Walking fish

Mexican walking fish (*Ambystoma mexicanum*), also called axolotls, are quirky creatures: Not only do these "fish" sport a protruding, spiky hairdo, they can also "walk." When they approach the bottom of a lake or canal, they pull out four legs from their sides to crawl around their swampy habitat in Mexico City.

Although they look like overdeveloped fish, they are actually amphibians. Often amphibians begin their lives equipped with gills so they can breathe underwater until they mature and lose their gills, ready for life on land. But axolotls keep their juvenile gills and remain in the water — a phenomenon called neoteny, according to an article in the journal *Nature*.

Never leaving the water, axolotls are found in the lakes of Xochimilco near Mexico City. Growing up to 12 inches (30 centimeters) long, they feed on small insects, worms, mollusks and crustaceans. Historically, these grinning creatures were at the top of the food chain, but invasive fish species — such as tilapia and carp fish, which eat baby axolotls — and pollution are now threatening their survival.

#### 4. Pregnant males

Females don't always have to bear the brunt of pregnancy. According to *Scientific American*, for seahorses, pipefish and sea dragons — members of the Syngnathidae fish family — it's the males that get pregnant. Seahorses and pipefish carry their young inside brood pouches, supplying nutrients such as energy-rich fats through the pouch tissue, while sea dragons' eggs simply stick to the outside of the males' tail.

Is there any benefit to this arrangement? Because the females can focus solely on egg-making (leaving other baby-rearing roles to the males),

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seahorses can give birth in the morning and be pregnant again by the evening, according to National Geographic. This helps the species' numbers increase for a higher chance of survival.

With the males carrying the babies, the females are also less likely to be drained of energy. Usually, the females expend more energy producing eggs than the males do producing sperm, according to Oxford Academic. By transferring egg-carrying duties to males, the energy demand is shared more evenly.

### 5. Parasitic mates

Male and female anglerfish are so varied in appearance that you might think they were different species at first glance. The females are up to 60 times longer and half a million times heavier than their male partners; as such, when scientists first observed the males with the female anglerfish, they thought that they were looking at a mom and her young, according to an article published in a journal of the American Society of Ichthyologists and Herpetologists.

The most common images of anglerfish show the females. Found lurking mostly in the darkest depths of the Atlantic and Antarctic oceans, female anglerfish look like the stuff of nightmares: Light rods hang from their faces and terrifyingly large fangs protrude from their mouths.

But the arrival of the males makes everything even more peculiar. When mating, a male anglerfish acts like a parasite, according to New Scientist. Biting into the side of his chosen female, the tiny male fuses his body with hers so he can steal her nutrients by sucking out her blood. Since the male has no need to swim or see, his eyes, fins and some major organs begin to deteriorate. He gets everything he requires for little effort, while his only responsibilities are to provide reproductive cells when the time is right. At that time, the male and female release their sperm and eggs, respectively, into the water for fertilization, Live Science previously reported.

### 6. Immortal jellies

Do you ever wish you could jump back in time to when you were young and start life again? As time passes, our bodies are designed to grow, age and eventually die. However, not all species follow this cycle. Meet the immortal jellyfish, *Turritopsis dohrnii*.

When injured or in the face of starvation, this jellyfish can push the "reset" button, according to the American Museum of Natural History (AMNH). With that reset, the jellyfish adults reverts back to an earlier developmental

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stage, in this case a polyp. That new polyp then continues the life cycle and spawns lots of genetically identical medusas, or the tentacled creatures we call jellyfish. Scientists think the immortal jellyfish use a process called transdifferentiation to pull off this rejuvenating feat. In this process, an adult cell that has become specialized for a certain tissue can transform into a different kind of specialized cell, AMNH said.

At their largest, adults of this jellyfish are still less than 0.2 inches (5 millimeters) across. These jellyfish were first discovered in 1883 in the Mediterranean Sea, but they only gained the moniker of the immortal jellyfish in the mid-1990s. While a German student was studying them in a lab, he noticed the bizarre phenomenon. When the medusa stage of the jellyfish got stressed, it fell to the bottom of the holding jar and reverted straight into polyps, skipping any fertilization or larval stages, according to *The Biologist*, published by the Royal Society of Biology. The researchers liked it to "a butterfly transforming back into a caterpillar."

Next, researchers hope to figure out how the jellyfish accomplishes its everlasting life. "The genome of *Turritopsis dohrnii* is being investigated and decoding it will be the first step towards the search for an 'immortality switch,'" according to *The Biologist*.

[livescience.com](https://www.livescience.com), 30 June 2021

<https://www.livescience.com>

### Gut bacteria may 'talk' to the brain, mouse study suggests

2021-07-01

Mice carry a teeming community of bacteria in their guts, and these gut bugs influence how the rodents' brains work, according to a new study.

Specifically, researchers wanted to find out how gut bacteria influence the activity of brain networks involved in mouse social behavior. Normally, when a mouse encounters a mouse it's never met, the two rodents will sniff at each other's whiskers and clamber over each other, much like how two dogs might greet each other at a dog park. However, germ-free mice, which lack gut bacteria, actively avoid social interactions with other mice and instead remain strangely aloof.

"The social impairment in germ-free mice, that's not new," said first author Wei-Li Wu, an assistant professor at the National Cheng Kung University in Taiwan and a visiting associate at the California Institute of Technology.

**Specifically, researchers wanted to find out how gut bacteria influence the activity of brain networks involved in mouse social behavior.**



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But Wu and his team wanted to understand what drives this standoffish behavior — do gut bugs actually influence which neurons fire in the mouse brain, and thus affect a rodent's willingness to mingle?

Stranger danger

The first time Wu heard that bacteria could influence the behavior of animals, he thought, "That sounds amazing but a little bit unbelievable," he told Live Science. But as a postdoctoral scholar at Caltech, he began running experiments with germ-free mice and witnessed their odd social behavior firsthand. While these strange behaviors had been described in various studies, Wu wanted to understand why they emerged.

In their new study, published Wednesday (June 30) in the journal *Nature*, the researchers compared the brain activity and behavior of normal mice with that of two other groups: mice raised in a sterile environment to be germ-free and mice treated with a powerful cocktail of antibiotics that depleted their gut bacteria. (As soon as the germ-free mice entered an unsterile environment, they would start picking up bacteria, so the researchers could use this batch only once; the antibiotic-treated mice were more versatile and could be used for multiple experiments.)

The team placed their germ-free and antibiotic-treated mice in cages with unknown mice, to observe their social interactions. As expected, both groups of mice avoided interactions with strangers. Following this behavioral test, the team ran a multitude of experiments to see what was happening in the animals' brains that may have driven this odd social dynamic.

First, the team examined the animals' brains for c-Fos, a gene that switches on in active brain cells. Compared with the normal mice, the mice with depleted bacteria showed heightened c-Fos activation in brain regions involved in stress responses, including the hypothalamus, amygdala and hippocampus.

This spike in brain activity coincided with a spike in a stress hormone called corticosterone in the germ-free and antibiotic-treated mice, while the same increase did not occur in mice with normal microbiomes, or communities of microbes. "After social interaction — it's just a five-minute interaction — I can clearly see that ... they all have higher stress hormones," Wu said.

Corticosterone primarily gets produced by the body's central stress response system, known as the hypothalamic-pituitary-adrenal (HPA) axis;

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the HPA axis links two brain structures (the hypothalamus and the pituitary gland) to the adrenal glands located on the kidneys. After seeing a spike in corticosterone in the germ-free mice, the team wondered if messing with the HPA axis could bring those levels back down and "correct" the rodents' behavior.

The team first looked at the adrenal gland, the last component of the HPA axis. They found that removing the adrenal gland appeared to boost the mice's social behavior; upon encountering a stranger, the mice without gut bugs behaved similarly to those with normal microbiomes. Blocking the production of corticosterone with drugs also increased the rodents' sociability, as did blocking or deleting the receptors that bind corticosterone in the brain, known as glucocorticoid receptors. Without receptors to bind the stress hormone, the mice didn't respond to spikes in corticosterone.

The team then did more experiments targeting the hypothalamus, the first component in the HPA axis. They zoomed in on a specific population of brain cells that produce corticotropin-releasing factor (CRF), a peptide that triggers a chain reaction of activity along the HPA axis and is key for corticosterone production. They inserted specifically designed receptors onto CRF neurons in the hypothalamus, which allowed the team to switch those neurons on and off at whim using a specific drug. Switching off the neurons in antibiotic-treated mice boosted their sociability toward strangers; conversely, switching on the cells in normal mice caused them to suddenly avoid social interactions.

This finding hinted that these hypothalamus cells might be overactive in germ-free mice and that somehow, gut bugs help tune them down in normal mice. This would, in turn, modulate the activity of the HPA axis and the production of stress hormones.

Backing up this theory, the team found that introducing the bacterium *Enterococcus faecalis* into the germ-free and antibiotic-treated mice also promoted social activity and reduced corticosterone levels in the animals. "When they put it back in, it seemed that the social behavior was 'rescued,' so to speak," said Diego Bohórquez, an associate professor and neuroscientist at Duke University School of Medicine who studies the gut-brain connection and was not involved in the study.

But while the team specifically highlighted *E. faecalis*, in reality, Bohórquez said he suspects an array of microbes work together to modulate stress hormone production.

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Collectively, these experiments made a strong case that, in normal mice, gut bugs somehow modulate the production of corticosterone and help the animals engage in social behaviors, while germ-free mice deal with an overabundance of the stress hormone and thus balk at opportunities for social interaction, Bohórquez said. But how that works at the level of the gut remains unclear, he added.

“It was a logical step to go look into the brain, but there’s a big gap in terms of what’s happening between the gut and the brain,” he said. For instance, the gut produces its own endocannabinoids, a class of chemical messenger also found in the brain, and these chemicals engage with the HPA axis, he noted. Receptors for CRF can also be found in the gut. Now, the big question is how the gut microbiome might use these networks to “talk” to the brain, and thus help control behavior from the depths of the intestines, Bohórquez said.

“We still want to tackle, what, exactly, does this bacteria do to the body?” Wu said, echoing the sentiment. “I think that’s the clear pathway where we want to do further digging.”

Beyond mouse experiments, this line of research could someday help scientists treat individuals with neuropsychiatric disorders, such as anxiety and autism spectrum disorder, assuming some of the observations in animals carry over to people, Bohórquez said. Research suggests that anxiety and autism often coincide with gastrointestinal disorders, such as constipation and diarrhea, as well as with disruptions of the gut microbiome, scientists have reported in the journals *General Psychiatry* and *JAMA*. For the past decade, scientists have been investigating this gut-brain link in hopes of developing new treatment approaches for such disorders, Bohórquez said.

“This specific work, I don’t know if it moves the needle forward” in terms of crafting microbiome-based treatments for autism, he added. But in general, “they are bringing more granularity in terms of how these microbes affect social behavior,” he said.

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<https://www.livescience.com>

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### Owls, swallows and bluebirds: the secret allies of farmers

2021-07-02

Dennis Tamura never set out to be a bird-watcher.

He’s been a farmer for over 35 years, and he and his wife grow organic vegetables and flowers on Blue Heron Farms outside Watsonville. But birds have become a part of the farm’s ecosystem.

About 15 years ago, a bird-loving neighbor put up small wooden bird boxes on the fence posts that line Blue Heron Farms, and Tamura just started noticing the tree swallows and Western bluebirds that came to visit. Today, he points out a fluffy baby tree swallow, its comically large yellow mouth peeking out of a hole in the box.

“The parents come by and you’ll see that their mouth is always wide open. ‘Hey, come on! I’m hungry!’” he said with a laugh. “It’s always kind of fun to watch.”

Farmer Dennis Tamura stands in one of his farm’s fields on June 10, 2021. Tamura says having the barn owls, tree swallows and Western bluebirds nest in boxes on his farm has done more than just offer pest control. They help him see his farm more deeply. (Lisa Morehouse/KQED)

“Their habit is to just fly and dart around pretty low because they’re snagging insects on the fly. And then they swoop in and feed — boom — immediately, and then they turn around and go back out,” he said.

Just like he described, a handsome tree swallow, with its white belly and iridescent blue back, flew low over the crops, then turned toward a bird box.

“They feed them instantaneously. It’s pretty interesting,” he said.

Without landing, the parent put an insect in the baby’s mouth.

One insect Tamura worries about is the flea beetle, which loves eating plants from the Brassica family, like broccoli and bok choy. Some of the damage caused by the flea beetles is just cosmetic, he said. “But sometimes they can outright kill plants.”

Right around this time of year, when the birds begin to leave, he said, “I notice that there’s a lot more flea beetle damage.”

**But birds have become a part of the farm’s ecosystem.**

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So the birds help with pest insects, and they're getting something back from the farm.

### Important Allies

Those bird boxes are simple, but they're important. Pesticide use and habitat loss shrunk the bird population in North America by almost 3 billion since 1970. That's nearly a 30% drop. The whole ecosystem feels that loss, since birds pollinate plants, and, like on this farm, control pest insects.

Birds like tree swallows and Western bluebirds would naturally build nests in tree cavities, but the plywood boxes all over the farm are a good substitute.

They also work well for barn owls. In his barn, Tamura pointed out the one box where barn owls have nested the last eight years or so, and help control his top rodent problem.

"There are a lot of gophers. I mean, we trap them but there's no way we're going to get them all," Tamura said.

On Blue Heron Farms, an adult tree swallow feeds its baby on June 10, 2021. The swallows swoop low over the fields picking off insects mid-flight. Often, they're feeding their young flea beetles, insects that can cause damage to crops. (Lisa Morehouse/KQED)

White droppings and clumps of regurgitated gopher cover the barn floor. Owls eat their prey whole and cough up the fur and bones, which they can't digest.

Taking a look at the mess left behind by the birds, Tamura said, "Well, they eat a lot of gophers. It's pretty astounding."

Jo Ann Baumgartner runs Wild Farm Alliance, a nonprofit that helps farmers support, and benefit from, wild nature. The organization has developed a Songbird Farm Trail to map locations with bird boxes, monitor changes in bird population and encourage more participation.

"We want to see a million bird boxes," she said. She added little metal tags to the bird boxes on Blue Heron Farm, and will observe bird behavior here. Monitoring bird life in boxes will add to the growing citizen science and academic research about beneficial birds.

These studies used to be common, Baumgartner said. "Back in the 1880s, the precursor to the USDA started studying how important birds were for

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eating pest insects and rodents. They asked farmers to shoot birds, which you could never do today, and pickle their stomachs and mail them in."

These researchers studied the birds' stomach contents, she explains, which led to a flurry of research papers published afterward on this topic.

When pesticides gained wide use, Baumgartner said, these studies fell by the wayside. But, over the last two decades, researchers have started to study once again the benefits birds provide to farms.

Matt Johnson, professor at Humboldt State University, spends his days studying the relationship between birds and farms.

'A lot of that habitat is gone and has been replaced by vineyards.' Matt Johnson, professor at Humboldt State University

He said that in Napa County, where he conducts his research, "the Wappo were the indigenous people here. They managed this place with a lot of traditional fire, keeping it an open grassland, with huge oaks that the first European colonizers waxed poetic about."

But he added, "a lot of that habitat is gone and has been replaced by vineyards."

Matt Johnson checks on his phone the live images transmitted from a GoPro camera to monitor the activity of the barn owls inside the bird boxes on March 14, 2021. (Lisa Morehouse/KQED)

Johnson drove through a vineyard in American Canyon, stopping to check owl boxes for nests or eggs. He got out of his truck and walked towards an owl box about 15 feet off the ground and pointed out the scratches on the outside of the hole, a good sign that there'd been recent activity.

Quietly approaching the box, he extended a painter's pole with a GoPro camera attached to the top, which connects to his phone. Slipping the GoPro into the box, Johnson looked at his phone to get a view of what's inside.

"Male and female," he whispered. "I can see an egg underneath the female. I'm going to get out of there."

People have built birdhouses for centuries, and Johnson says that farmers from Chile to South Africa put up barn owl boxes because they've seen barn owls eat rodents on their farms.

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"They don't necessarily need a lot of scientific evidence to show that this is working. They're seeing it on the ground," he said. The academic research on the impact of owls on farms, however, was slim, so Johnson began the Barn Owl Research Project in 2015.

"Now we have some scientific evidence," he said.

Matt Johnson's research team places cameras near the bird boxes it manages to keep track of the behavior of the birds. This is the inside of one of the boxes. (Courtesy of Matt Johnson)

Johnson's team installed infrared cameras in owl boxes all over Napa Valley to monitor what owls hunted at night, and placed GPS trackers on owls to see where they hunted.

'They don't necessarily need a lot of scientific evidence to show that this is working. They're seeing it on the ground.' Matt Johnson, professor at Humboldt State University

"Our estimate is that a family of barn owls removes 3,400 rodents from the landscape every year," Johnson said. "So some of these farms, like this one that has 20 occupied boxes, you're talking about 70,000 rodents removed every year."

Their research showed that one-third of these rodents came directly from vineyards.

This vineyard was started by the man who helped put California wines on the map.

In the mid-'70s, Miljenko "Mike" Grgich was the winemaker for Chateau Montelena, the vineyard that beat French wine in a taste test that became known as the Judgement of Paris. He went on to start Grgich Hills Estate, where his nephew, Ivo Jeramaz, continues the winemaking tradition.

While Johnson checked the barn owl boxes, Jeramaz walked by and said he'd love to add more to his vineyards. Johnson explained that after analyzing this season's data, his team can point out new locations that owls would probably like.

'Conservation With People'

A few weeks later, Johnson met up with three grad students at another Napa vineyard to collect data and place ID bands on barn owls to study them for years to come.

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They walked down to a box, wearing headlamps. First, they checked the owl box. Next, they set a trap for an adult returning to feed its young. The box is designed, Johnson explained, so that when an owl enters it, a little door swings shut and LED lights turn on.

After a short wait, they all see movement. "So an adult owl flew in," said Johnson. "We think it might be the female. She landed on the box and she's ..."

Before he finished his sentence, the light turned on. "Oh, there she is. She's inside! Let's go!"

The team quickly walked down to the box, set up a ladder and listened in to the parent feeding baby owls.

Making sure the adult didn't escape from the side door, Johnson asked one of the graduate students to shine a light inside the box while he reached in with a gloved hand to grab the owl's feet and pull it from the box.

The owl appeared, with its white wings spread wide out from its heart-shaped face. They put a little hood over its head to calm it down.

Laura Echávez, member of Matt Johnson's research team, attaches a USGS metal ID band on a barn owl on March 30, 2021. After carefully taking measurements, the team makes sure to return each owl to its birdbox. (Lisa Morehouse/KQED)

When they got back to the truck, graduate student Laura Echávez said that the next step is to take a metal band issued by the U.S. Geological Survey and place it around the foot of the owl.

She held the owl with confidence and tenderness, talking to it softly as she secured the metal band. "Can you lift your head a little buddy?" she said. "There, perfect."

Then, after about 20 minutes of taking measurements and photos for their research, the team returned the owl to the box.

Johnson hopes his team's research can highlight the reciprocal relationship between farmers and wildlife.

Barn owls are one species that depend on oak trees, using the big cavities around the tree's trunk to build nests. But with the growth of the vineyards and other development, many oak trees in this valley have disappeared.

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“When farmers put up these nesting boxes, it’s amazing,” Johnson said.

“There’s an old conservation model where the idea is that we need to protect nature from people, and just lock it away and keep people out,” he explained. The flip side would be conserving nature exclusively for people.

“Neither of those is really quite right. I think we should think about conservation with people, you know, understanding that we are part of the ecosystem and we do things that negatively affect some species,” Johnson said. “We can also do some things that help species survive and they in return can help us.”

Researcher Matt Johnson explains that through his research he’s learned more about how much birds contribute to the well-being of humans, and ways humans can give back. A group of infant barn owls gather inside one of the bird boxes, in an image captured by the Humboldt State University barn owl research team. (Courtesy of Matt Johnson)

‘They’re Welcome to Be Here’

Back at Blue Heron Farms outside Watsonville, farmer Dennis Tamura says that having the barn owls, tree swallows and Western bluebirds nest in boxes on his farm has done more than just offer pest control — they help him see his farm more deeply.

“Seeing what you’re looking at, it’s different than just looking and watching,” he said.

“They’re welcome to be here because there’s plenty of food, as far as I can tell. For me, they just enhance the whole environment. And obviously they do some help for us.”

And, I pointed out, he provides a home for them.

“Yeah,” he said with a laugh, “I guess you could say that.”

That seems like a pretty fair trade.

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