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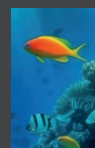
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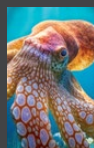
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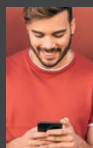
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# The Science of Fear: Why Do We Like SCARY MOVIES?

By Mark Miller

Do you like to watch creature features like *War of the Worlds* or gore fests like *Evil Dead*? How about a post-apocalyptic zombie flick like *28 Days Later*?

No matter which horror title or genre you prefer, you'll probably react to these types of films with emotions that aren't desirable in real life: fear, dread, revulsion, anxiety, disgust, or a combination of these feelings. Now, scientists are trying to understand why we enjoy these types of reactions when they're associated with watching scary movies.

## Feel-Good Fear

According to the NBC News report "A Fondness for Fear: Why Do We Like to Be Scared?" fear releases dopamine in some people. Dopamine is a type of neurotransmitter and hormone that helps us experience pleasure or happiness, which may be why frightening experiences have a positive effect.

Christopher Bader, PhD, a sociology professor at Chapman University in California, added in the report that "fear responses produce endorphins, which can be a sort of natural high." Endorphins are another type of hormone. They can be increased in the brain by exercising or completing other activities and help relieve pain and improve mood.

## Focus Factor

Fans of horror films may also enjoy being frightened because it makes them feel alive.

This is because fear focuses our attention and puts us in closer touch with our bodies. When you're terrified that an axe murderer is about to claim another victim, you're enthralled by what's happening on the screen. You've forgotten about real-life concerns, relationships, and responsibilities.

This focus offers a form of escapism and can even create the sense that we've faced and conquered our fears and anxieties. "You're in the moment, and afterwards you feel like you overcame a challenge, so you feel more confident..." Margee Kerr, PhD, a sociologist and fear researcher at the University of Pittsburgh, told NBC News.

## Types of Fans

In trying to explain why people enjoy horror films, a team directed by Mathias Clasen from the Recreational Fear Lab at Aarhus University in Denmark conducted surveys that revealed three types of horror fans and why they watch:

**Adrenaline junkies** reported immediate enjoyment, but, according to the article "What's the fun in fear? Science explores the appeal of scary movies" from *Science News Explores*, they didn't feel they had gained anything else from their experience.

**White knucklers** seemed to endure rather than enjoy their horror encounters, "but they were much more likely to report feeling like they had learned something about themselves," said Clasen in the article.

**Dark copers** combined these two responses; they received immediate enjoyment and felt like they had learned or grown.

## Never Fear

Regardless of what fan category you may fit into, one of the overarching conclusions of the research is that horror movies aren't for everybody—and nobody reacts to them in the exact same way. You should never be afraid to express that you don't enjoy scary movies, and if you see something in a horror film that disturbs you, talk to someone about the experience if you think it will help.

### DISCUSSION QUESTIONS

Name three physical reactions the human body has when you're afraid.

Besides exercise, what is another way to help your body produce endorphins?

Describe a specific scenario where fear is beneficial.

### VOCABULARY

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# Trees Share Some Survival Secrets Through Ultrasound

By Lynne Lescott

Trees give us shade on hot days and tasty fruit to eat and they help the planet, but did you know trees can also eat, drink, and get stressed out like we do? Environmental scientists have long studied how trees grow and survive. As the effects of climate change become more intense, scientists are focused on how trees use their resources to survive drought and other environmental conditions.

## How It Works

Over the years scientists have learned that trees have channels like plumbing pipes that help them eat and drink. These phloem channels send nutrients created by photosynthesis from a tree's leaves down to its storage organs and new growths. The xylem channel "sips" water and minerals from soil, then pushes it to the tree's roots and upward.

Dry spells change how trees drink. During dry spells the xylem starts to gulp water instead of sipping it, like we gulp water on hot, dry days. When trees gulp instead of sip, embolisms, or air bubbles, can flood their channels. If a tree's environment stays dry for too long the embolisms can build up, plug the channels, and prevent the delivery of water and nutrients to different parts of the tree.

Environmental scientists call this drought stress, and it can be bad news for trees when dry conditions persist.

## Studying Drought Stress

A team of ecophysiologicalists at the University of Innsbruck in Austria set out to learn how mature trees manage resources during a drought, and if they bounce back after. The team also wanted to compare trees under drought stress to trees experiencing natural conditions. They couldn't bring fully grown trees into their lab or wait for a drought, so the team set-up an in vivo experiment, a study of whole living organisms, in Germany's Kranzberg Forest.

The team designed a five-year study that simulated a long drought in nature. They created drought conditions by building stands with removable roofs over some of the trees, which prevented rain from falling directly on the trees and soil beneath. The roofs were removed each winter and added back each spring, but the stands stood steadily for five years.

All the trees in the experiment were monitored for five years. One data point measured was the embolism level of each tree. The team placed ultrasound sensors on tree trunks to capture signals from drought-condition and natural-condition trees. The signals were created by waves bouncing off of the embolisms. The data revealed that the drought-condition trees generated more signals than natural-condition trees, indicating they had more embolisms. Increased embolism levels meant the trees' overall resources were stressed.

## Protecting Trees and the Planet

The good news? The trees bounced back when the research team re-irrigated the dried soil to help restore natural conditions. They monitored the trees' photosynthesis rates, embolism levels, and soil health for several post-drought seasons.

As climate change produces effects faster than the environment can adapt, the Kranzberg Forest experiment and other research can help environmental scientists learn, and inform strategies that help protect the world's resources.

### DISCUSSION QUESTIONS

Why did the research team remove the roofs over the drought-condition trees each winter?

Based on this experiment, what additional research could be done to learn how to protect trees from the effects of climate change?

### VOCABULARY

EMBOLISM

ECOPHYSIOLOGIST

IN VIVO



# Old Masters Used Eggs to Preserve Oil Paintings

By Celeste Beley

Art is often used to teach science, but what you may not realize is that science can explain a lot about art. We think of the Renaissance artists like da Vinci and Botticelli as geniuses with a paintbrush and canvas. As it turns out, they also needed to be savvy scientists. Their scientific techniques are what allow us to view their brilliant masterpieces today.

Until the 15th century, the dominant medium used by artists was egg tempera paint. Classical egg tempera is traditionally created by hand-grinding dry powdered pigments into a binding agent or medium, such as egg yolk, milk (in the form of casein), and plant gums. Renaissance-era painters replaced egg-based paints with oil-based paints as the dominant medium, but during the transition started using eggs mixed with oil-based paints. Why and how they continued to do this has been a mystery until now.

## The Science Behind the Art

According to a paper published in *Nature Communications*, a team of researchers based in Germany and Italy have identified not only why the Old Masters would have added eggs to their paints but also how.

“The egg is used for modification and fine-tuning of paint properties,” said Patrick Dietemann, PhD, of the Doerner Institut in Germany and one of the co-authors of the paper. The team created two types of egg paint mixtures to experiment with: one

consisted of pigment ground with linseed oil and a few drops of egg yolk and the second was comprised of pigment mixed with a solution of diluted egg yolk that was dried, ground, and dispersed with oil. They determined that changing the preparation technique enabled changes to the property of the paint.

In the first preparation, the team found that the paint could be made very stiff. This allowed the artist to apply heavy layers that do not spread, a technique known as *impasto*.

“In addition, the stiffness of the lower layers of paint prevents the paint surface from cracking or wrinkling during drying,” said Norbert Willenbacher, PhD, a co-author from the Karlsruhe Institute of Technology.

In the second preparation, the team discovered that humidity had less influence on the paint. “The yolk protects the paints from undesirable changes caused by absorption of moisture from the environment because the water is captured in the protein layer [surrounding the pigments],” noted Willenbacher.

The study revealed that adding egg yolk increased the drying time of paints due to its phospholipids and antioxidant properties, which also help protect from long-term oxidation and degradation.

## Masterful Preservation

The researchers believed the artists made a very intentional choice to add eggs to their paints. “I am quite convinced that they did not know the chemical and physical explanations of what they were doing, but they knew very well what they were doing,” said Ilaria Bonaduce, analytical chemist at the University of Pisa and one of the study’s co-authors.

This just proves that a little bit of scientific experimentation can go a long way. Thanks to these accidental scientists, we can all still enjoy their masterpieces today.

## DISCUSSION QUESTIONS

In what other ways do we use science to help protect and restore ancient artworks? Talk with an artist or art teacher. What other additives are mixed with paints to change the texture and why?

## VOCABULARY

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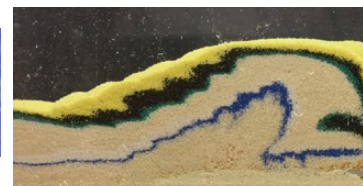
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# Paving the Way

## Cephalopods: Masters of RNA Recoding

By Iva Fedorka

Even small changes in genetic instructions can affect the proteins an organism produces. Octopuses, squids, and other cephalopods seem to be able to modify their RNA without significantly changing their DNA. This ability to edit their RNA may provide them with options for facing life's challenges.

### What Is RNA Editing?

Instructions for maintaining life are contained in an organism's DNA. Messenger RNA (mRNA) copies the DNA, which the ribosomes use to create proteins from amino acids. RNA recoding produces a protein that does not include the exact amino acids that the message prescribed.

Almost every multicellular organism has one or more RNA-editing or ADAR enzymes. Scientists have also discovered millions of human RNA locations where editing occurs, but the process rarely affects the protein structure.

Cephalopods most often use adenosine to inosine (A-to-I) editing, enzymatically removing one nitrogen and two hydrogen atoms from adenosine to create inosine. The ribosomes then substitute inosine for guanine when creating proteins.

### Recoding in Cephalopods

Humans and other vertebrates typically create these protein variations using copies of a gene, not RNA editing. In contrast, cephalopods have tens of thousands of recoding sites, mostly in their nervous systems. Although it's been suggested that recoding helps

the animals respond more flexibly to their environments, the true evolutionary value is unclear.

Kavita Rangan, a molecular biologist at the University of California, San Diego, has been studying RNA recoding in longfin fish and California market squid (*Doryteuthis opalescens*).

Although the potential number of editing combinations is large, Rangan and Samara Reck-Peterson, also of UC San Diego, found that certain sites are often edited simultaneously. This restricts the number of potential edits and may offer a way to test protein versions without permanently changing the DNA. These results were reported in a September 2022 preprint post at bioRxiv.org (operated by Cold Spring Harbor Laboratory).

### Editing and Evolutionary Advantage

The same thought occurred to Jianzhi Zhang, an evolutionary geneticist at the University of Michigan in Ann Arbor. "It doesn't make sense to me," he told *Science News* in 2023. "If you want a particular amino acid in a protein, you should change the DNA. Why do you change the RNA?"

To test whether the RNA editing offered an evolutionary advantage, Zhang and Daohan Jiang, a former graduate student, compared sites where the edits do not change amino acids with those that do. Their results, published in *Nature Communications* in 2019, showed that cephalopod recoding is not advantageous or adaptive in most cases.

### More Unanswered Questions

Scientists would like to directly test whether recoded RNA has an effect on cephalopod biology, but that requires new tools and creative thinking. Currently, researchers remove tissue and observe it microscopically, but a cell culture line would allow for longitudinal studies.

Zhang is also testing a strain of Baker's yeast (*Saccharomyces cerevisiae*) by incorporating a human ADAR enzyme. Other researchers are changing squid genes using CRISPR/Cas9 and have even created an albino squid by disabling its pigment-producing genes.

### DISCUSSION QUESTIONS

- How many amino acids are known to exist?
- Does the human body produce any amino acids?
- What are essential and nonessential amino acids?

### VOCABULARY

- AMINO ACID
- CEPHALOPOD

# Food for Thought: Highly Processed Foods May Be Harming Your Body and Mind

By Gina Wynn

As we struggle to keep up with busy work and school schedules, some of us turn to highly processed foods (HPF) when we need a tasty, reliable meal hack. When we're short on time and low on energy, it's easy to heat up a frozen pizza or a hot dog and fries for dinner, grab a cookie, doughnut, or ice cream for a snack, or pick up an exotically flavored soda as a thirst quencher.

Although these quick food fixes are delicious and satisfying, they could be affecting our health. Several recent studies show that HPF have been linked to dementia, diabetes, obesity, and other health conditions.

## Moderation Is Key

Health problems are more likely to occur if you overindulge in HPF or eat them consistently without incorporating fresh fruits, vegetables, nuts, and other nourishing foods into your diet. It can be difficult to consume HPF in moderation, however. Findings from the study "Highly processed foods can be considered addictive substances based on established scientific criteria," published in the journal *Addiction*, determined that they are addictive.

Using the four criteria set by the Surgeon General in 1988 to identify tobacco products as addictive, researchers Ashley N. Gearhardt and Alexandra G. DeFelicantonio evaluated the addictive potential of HPF like potato chips, candy, and store-bought cookies. They concluded that they can meet the criteria to be labeled as addictive substances.

## Comfort Food

The carbohydrate and fat combinations in HPF—that don't occur naturally in unprocessed foods—make it easy to form habits of

Maintaining diets of high-sugar, high-calorie foods indefinitely can contribute to future health issues, including **obesity**, **respiratory illnesses**, and **depression**.

overconsumption. They cause you to continue to crave them, even if you're not hungry.

Our bodies have evolved to find comfort in the tastes of carbohydrates and fats. Earlier humans depended on them to avoid famine and improve their chances of survival, according to Gearhardt, as reported in the *Science News Explores* article "Ingredients in popular snack foods can make them addictive." When we ingest these substances, our bodies send a rush of the feel-good chemical dopamine to the reward center of our brains. Alcohol and drug use can also prompt such a dopamine release.

It's easy to get addicted to the sensation you experience when biting into your favorite treat. However, repeatedly overeating because it feels good can lead to obesity, which can cause health conditions like type 2 diabetes, heart disease, stroke, and many types of cancer.

## Empty Calories

Another problem with HPF is that they lack the vital nutrients that our bodies and minds

need to thrive. When more than 20 percent of our daily calories are from HPF, it can affect the way our brain processes information and makes decisions, according to the report "Association Between Consumption of Ultraprocessed Foods and Cognitive Decline," published in *JAMA Neurology*.

Researchers followed over 10,000 Brazilians with an average age of 51 for up to 10 years. They asked participants about their diets and tested them for immediate and delayed word recall, word recognition, and verbal fluency.

"People who consumed more than 20 percent of daily calories from processed foods had a 28 percent faster decline in global cognition and a 25 percent faster decline in executive functioning compared to people who ate less than 20 percent," study coauthor Natalia Gonçalves told CNN Health for the article "Dementia risk may increase if you're eating these foods, study says."

Conversely, the team found that in participants who otherwise ate a high-quality diet that included unprocessed foods, the cognitive decline linked to HPF disappeared. Another study published in *Science Direct*, "Multivitamin Supplementation Improves Memory in Older Adults: A Randomized Clinical Trial," showed that older people who took multivitamins for three years were able to slow typical age-related memory decline. This supports growing evidence that nutrition is important for maximizing brain health.

## Long-Term Implications

Good nutritional practices also have long-term benefits. In a study of the typical poor eating habits of college students, researchers found that the eating patterns they establish as students can affect their overall wellness throughout life. Maintaining diets of high-sugar,





high-calorie foods indefinitely can contribute to future health issues, including obesity, respiratory illnesses, and depression. The findings were published in the *Science Direct* report “Does obesity related eating behaviors only affect chronic diseases? A nationwide study of university students in China.”

### Nutrition Matters

The results of all these studies reinforce the same message. To take proper care of our bodies and minds, we must pay attention to

what we eat. Consuming too many HPF can limit our abilities to live up to our full potential, both physically and mentally.

Instead, choose nutrient-dense foods and beverages, including fruits, vegetables, grains, dairy products, and protein foods such as lean meats, eggs, and nuts. Follow a healthy dietary pattern and stay within calorie limits appropriate for your stage of life as recommended by the USDA Dietary Guidelines for Americans, 2020–2025. Learn more about the eating pattern and physical activity program that’s right for you by consulting with your healthcare provider.

### DISCUSSION QUESTIONS

Name some highly processed foods or drinks that you have consumed recently.  
What are some unprocessed, nutrient-dense foods that you enjoy?

### VOCABULARY

- DOPAMINE
- NUTRIENT
- PROCESSED



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# How AI Can Hurt or Help in the Classroom

By Mark Miller

Educators and students may be able to turn the AI threat into an AI opportunity.

The artificial intelligence (AI) tool ChatGPT was released free of charge at the end of November 2022 by the research company OpenAI. The article “Think twice before using ChatGPT for help with homework” by Kathryn Hulick published in *Science News Explores* states that it attracted over a million users within a week. A key reason for this rapid popularity is that ChatGPT isn’t a complex compilation of computer code; it’s an advanced chatbot you converse with to generate useful content about virtually anything. Simply enter a request like “write me a brief essay about zebras” and it returns around 500 words of clearly written prose. Here’s an example:

## **Zebras: The Striped Wonders of the Animal Kingdom**

Zebras, with their distinctive black-and-white stripes, captivate the imagination of both nature enthusiasts and casual observers alike. These charismatic creatures, members of the equid family, are native to the grasslands and savannas of Africa.

## **Cheaters Beware**

It didn’t take long for students to realize that an online tool that provides humanlike answers, essays, reports, and more could not only help with their schoolwork; it could *do* their schoolwork. According to a report from *Insider*, a Study.com survey found that more than one in four K-12 teachers said they had caught at least one student cheating using ChatGPT.

And ChatGPT isn’t the only option. Google’s Bard, Jasper.ai, Claude, and other AI tools offer similar capabilities—and opportunities for cheating. However, ChatGPT appears to be the example most educators use to call out AI’s potential perils. The education department of New York City blocked the use of ChatGPT from its devices and networks, and so did school districts in Baltimore and Los Angeles, according to educational reporting resource *Chalkbeat*.

Cheating isn’t the only concern. ChatGPT content can be considered unsafe, biased, and inaccurate. “Confidently wrong” is how Casey Fiesler, an ethics and technology expert at the University of Colorado Boulder, characterizes misinformation from ChatGPT in Hulick’s piece. In one example cited,

ChatGPT said that the peregrine falcon was the fastest marine mammal. Fiesler’s work also reveals the troubling fact that ChatGPT offers no sources. When asked to provide them, ChatGPT responded with false ones and presented them as valid.

If ChatGPT provides no sources, where and how does it get its information?

## **How It Works**

Tools like ChatGPT are natural language processing applications. In other words, they communicate through everyday speech. They’re built using machine learning—a branch of AI that enables computers to teach themselves to perform tasks. Previously, computers required detailed instructions to perform a task, but with machine learning, they can develop skills on their own by analyzing large amounts of data.

Hulick explains that ChatGPT uses a type of machine learning known as a large language model to analyze vast amounts of text—around 300 billion words and other types of language examples—until it learns to predict which words are likely to occur in a phrase or sentence. It does this by creating a 3D map of words that relate to each other, like “salt and pepper” or “dead or alive.” Based on the model and reinforcement from human feedback, ChatGPT responds with an amazing array of constructions and styles, and it improves as it’s given more data.

The results are very convincing. A briefing from the science journal *Nature* reports that abstracts for research papers created with ChatGPT fooled a team of professional reviewers. In a test, they missed identifying over 30 percent of the abstracts generated by AI.

## **Here to Help and Here to Stay**

Despite some dangers and disadvantages, there are ways in which AI applications like ChatGPT can aid learning. Rather than simply copying and pasting AI-generated material into their work, students can use these tools to generate ideas, jump-start research, and build writing and editing skills.

Leveraging AI in education may require changing how it is viewed. Treating it as a tutor or coach, rather than a cheating device,

could help students grasp difficult subjects more quickly. They could also use AI examples to learn how to compose and structure their writing more clearly and concisely. And it’s not just students that stand to benefit. Teachers and administrators can use AI to explore topics and subjects more efficiently and thoroughly to improve curricula and lesson plans.

These approaches should always include the important step of verifying the information that AI provides because—as we’ve seen with ChatGPT—no sources are provided and some of the responses may be incorrect.

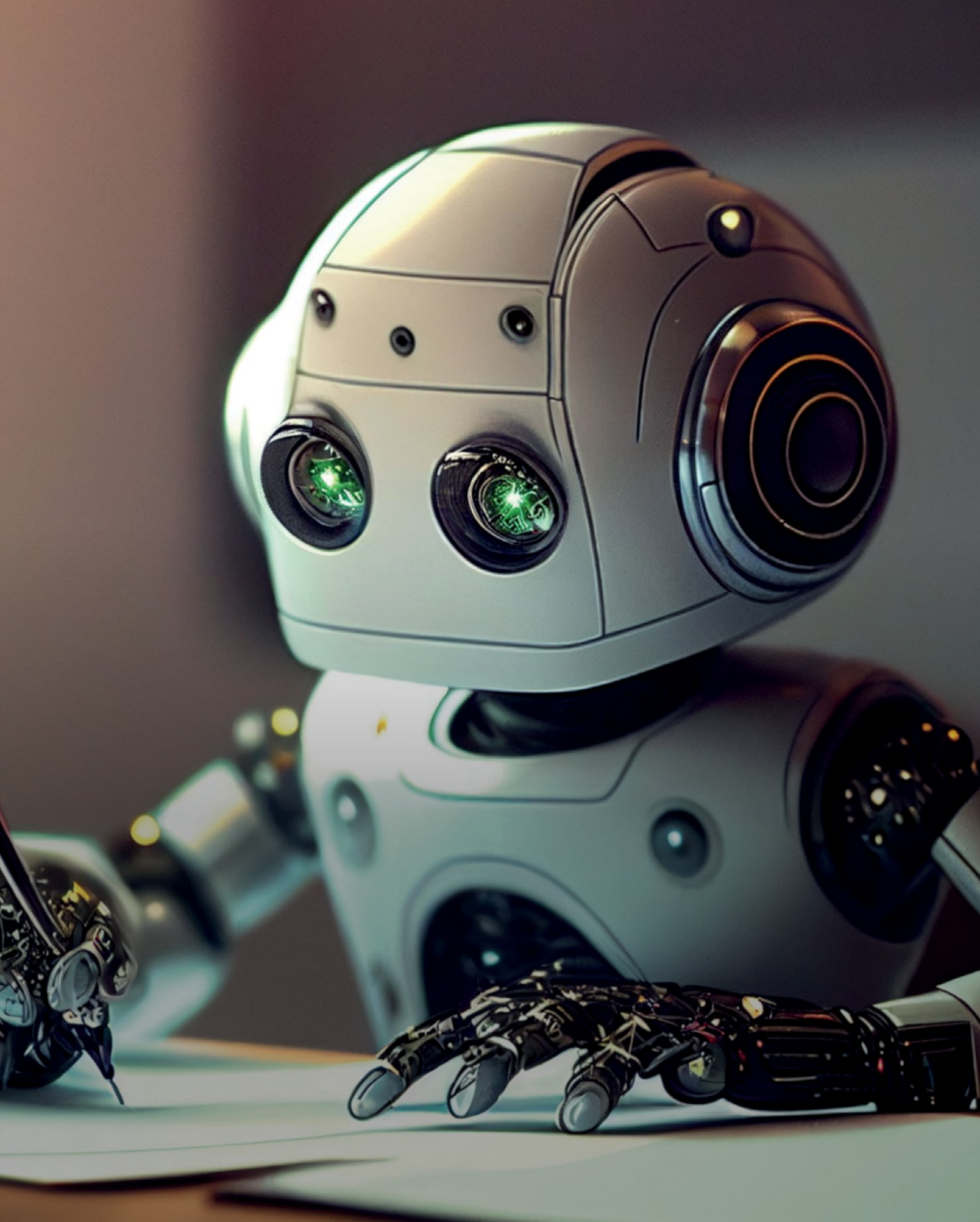
As Hulick points out, while AI tools may be new and exciting, this isn’t the first time technology has invaded the classroom. Teachers and students alike have adapted to using calculators for math and Google for finding and learning answers—the search engine was once viewed as harmful to knowledge retention by delivering volumes of facts with a single search. Ultimately, educators and students may be able to turn the AI threat into an AI opportunity by developing innovative ways to apply its capabilities to an evolving education landscape.

### **DISCUSSION QUESTIONS**

- Provide an example of AI from everyday life.
- Have you used ChatGPT or another AI tool as part of your schoolwork? Describe how and whether you think it helped you.
- Define and discuss three different types of machine learning.

### **VOCABULARY**

ARTIFICIAL INTELLIGENCE CHATBOT  
MACHINE LEARNING DATA





# Language May Help Shape Our Brains

By Kylie Wolfe

From the structure of words and sentences to how they sound, language exercises different parts of the brain. And because languages can be so distinct, the ones you learn and use may determine more than just who you communicate with or how you do so.

Researchers at the Max Planck Institute for Human Cognitive and Brain Sciences in Leipzig, Germany, found that native language may shape the brain and even the way we think. Their results were published in *NeuroImage* in April 2023.

## Exploring the Brain

The human brain consists of the cerebrum, cerebellum, and brainstem. The cerebrum, the largest of the three, is made up of symmetrical hemispheres. Within these hemispheres, our brain cells, or neurons, send and receive messages by forming connections with each other. They use these connections to interpret signals from our senses and to speak, learn, and move.

Among the cerebrum's list of skills is the ability to process language. Throughout life, we learn to communicate using at least one language—sometimes more. As that learning occurs, connections within and between the left and right hemispheres of the cerebrum are established and strengthened.

To further explore this brain-language relationship, neuroscientist Alfred Anwander and his team at the Max Planck Institute studied a group of 94 monolingual, or single-language speaking, adults. The volunteers spoke either German or Arabic, very dissimilar languages. Using magnetic resonance imaging (MRI) technology to scan each participant's brain, researchers noticed clear structural differences between the two groups.

"The specific difficulties [of each language] leave distinct traces in the brain," Anwander told *Science News*. "So we are not the same if we learn to speak one language, or if we learn another."

## Interpreting the Results

Researchers found that Arabic speakers have stronger connections across hemispheres, while German speakers have stronger networks within the left hemisphere.

The Arabic language can be complex—especially because it's written from right to left, which is not typical—and there are unique words and sounds that may require extra effort to decipher. German, on the other hand, is written left to right and offers more flexibility because words can be rearranged and still convey a similar meaning. These distinctions reinforce neurons and their pathways over

time, offering a possible explanation for the structural differences between the two groups.

It's also important to note that the Arabic speakers had recently moved to Germany, and although they did not speak German, their exposure to a new language may have led to more interaction between their left and right hemispheres.

As scientists study the brain and the way language affects it, they'll hopefully learn even more about the intricacies of this connection. The pathways used for language can also be used for other tasks—an interesting neurological wrinkle to explore in future studies.

### DISCUSSION QUESTIONS

How does learning a language affect the brain?

What might the benefit be of learning a new language, even as an adult?

### VOCABULARY

LANGUAGE

CEREBRUM

NEURON



# Spiders Need Rest, Too.

## But Do They Sleep?

By Gina Wynn



We're familiar with cat naps, but what about spider naps? Researchers who conducted a study of baby jumping spiders at the University of Konstanz in Germany found that they may indeed experience sleep cycles. Results of the study were published in the article "Regularly occurring bouts of retinal movements suggest an REM sleep-like state in jumping spiders," which appeared in the journal *Proceedings of the National Academy of Sciences*.

Daniela Roessler stumbled upon the idea of studying spider sleep patterns when she noticed spiders in the lab hanging from silk threads in their containers at night. While some aquatic animals, roundworms, and other arthropods have recently been shown to experience sleep cycles, it was unclear whether creatures like jumping spiders exhibited similar habits.

The spiderlings' overnight movements resembled REM sleep in other species—like dogs or cats—who **twitch** during sleep.

### Critters on Camera

To gain insight into the hanging behavior, Roessler and her team observed 34 four-eyed, furry arachnids at night using infrared cameras. Over three four-hour phases, they saw parts of their eyes flickering and their legs twitching and curling. They noted that these behaviors resembled activity typical of rapid eye movement (REM) sleep-like states in other species—like dogs or cats—who twitch during sleep, and that the movements occurred in regular cycles, as they do in humans.

Often associated with mammals and birds, REM sleep states alternate with non-REM sleep states several times throughout a normal night of sleep. They are characterized by increased activity in certain brain regions, depressed muscle tone, and rapid, multi-directional eye movements, and are associated with dreaming in humans.

Comparing sleep cycles in spiders to other

species can be challenging, as many spider-like creatures lack movable eyes. However, jumping spiders, which are predatory and have movable retinas so they can look around while hunting, provided a unique opportunity for observation.

implications, the researchers have more work to do. Roessler told *AP News* that they still need to understand whether the spiders are technically sleeping during their resting states. Further investigations will involve testing spiders while they appear to be sleeping to find out whether they respond more slowly or not at all to stimuli that would typically provoke a reaction.

As they delve deeper, the team hopes to answer important questions about the visual brain and the origin, evolution, and function of REM sleep. In short, they plan to let sleeping spiders lie...while keeping a watchful eye.

### Reservations About REM

Because spiders are so different from humans evolutionarily, some experts have reservations about whether spiders truly experience REM sleep. Jerry Siegel from the UCLA Center for Sleep Research is skeptical, according to the *AP News* article "Do spiders sleep? Study suggests they may snooze like humans." He believes that while some animals may display activity during rest, it's hard to consider it REM sleep.

Barrett Klein from the University of Wisconsin-La Crosse told *AP News* that the discovery of REM-like signs in spiders is exciting, but the prevalence of REM sleep among different species and its purpose remains unclear. Neither Siegel nor Klein were involved with the study.

### Let Sleeping Spiders Lie

To determine the nature and significance of spider sleep cycles and their evolutionary

#### DISCUSSION QUESTIONS

Do you think spiders sleep like humans do? Why or why not?

Why do you think scientists are interested in studying the sleep patterns of different animals, such as spiders?

#### VOCABULARY

ARACHNID ARTHROPOD

MAMMAL REM SLEEP

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# Warning: Social Media May Not Be Good for You

By Christina P. Hooton



If you've ever spent time on social media, you know it can be a powerful tool to connect people, but that it also has the potential to be harmful. United States Surgeon General Vivek Murthy, MD, recently issued an advisory warning about the detrimental effects of social media on young people's mental health.

## A Public Health Crisis

According to Dr. Murthy's report, "Social Media and Youth Mental Health," 95 percent of young people aged 13 to 17 reported using a social media platform, and more than a third said they use social media "almost constantly." The report also states that not enough research has been conducted to understand the full impact of social media on children and adolescents.

One of the critical factors to consider when assessing the influence of social media on young people is brain development. From ages 10 to 19, adolescents are still forming their identities and cementing their self-worth. This is a highly sensitive period during which they are especially susceptible to peer opinions and comparison. A study cited in the report found adolescents who spent more than three hours per day on social media had double the risk of experiencing poor mental health outcomes, including symptoms of depression and anxiety.

Additionally, on these platforms, young people can easily access extreme, inappropriate, and harmful content, such as live depictions of self-harm or racist content or language. Social media can also perpetuate body dissatisfaction, eating disorders, and low self-esteem. Forty-six percent of adolescents aged 13 to 17 said social media made them feel worse about their body image.

Despite the potential harm social media can inflict, the report cited some benefits. Fifty-eight percent of adolescents stated that social media makes them feel more accepted. They also said it's a place where they can show their creative side, and stay in touch with friends.

## Our Collective Responsibility

The surgeon general is calling on technology companies to be more transparent about the impact their products have on children and prioritize health and safety when it comes to platform design. At the same time, he is urging policymakers to implement stronger safety standards and better protect children's privacy.

Parents and children can establish tech-free zones and limit time on platforms, allowing for more in-person interactions at home. They can also block unwanted content, be careful

about sharing personal information, report inappropriate content, and reach out to friends they see being bullied online.

Ultimately, there is too much at stake to wait for the research to catch up. Encouraging young people to make healthy choices when using social media will benefit them now and in the future.

## DISCUSSION QUESTIONS

Think about your relationship with social media. Make a list of both the negative and positive aspects. Discuss different items on the list. Which list is longer?

Brainstorm ideas for making platforms like Facebook and TikTok safer for children and teens.

## VOCABULARY

SOCIAL MEDIA

ADOLESCENT

MENTAL HEALTH



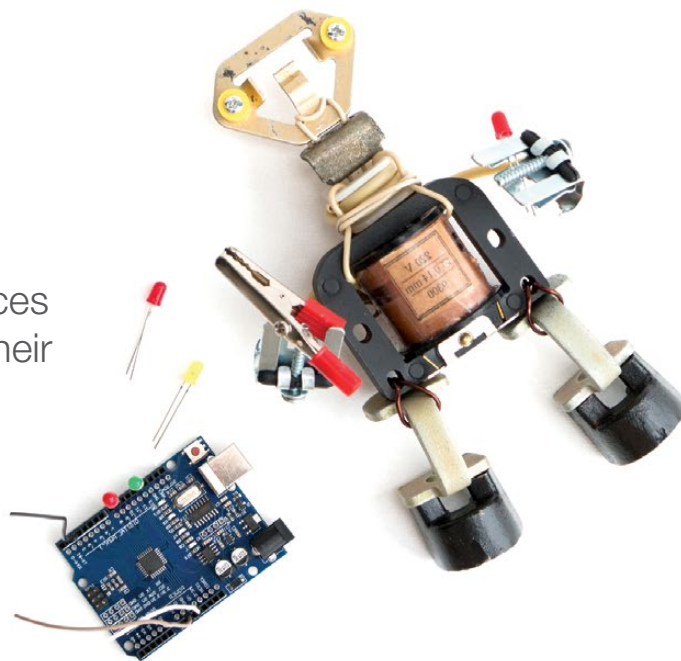
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# What Can Happen In the Blink of an Eye

By Iva Fedorka

Sighted people miss about a fifth of a second of vision every time they blink. Those 200 milliseconds may not seem like much, but when you're driving a car at 200 miles an hour, you could miss seeing 66 feet of track every time you close your eyes!

## What Is Blinking?

Blinking is a semi-autonomic action that takes place an average of 15 to 17 times per minute in humans. A blink cleans the surface of the eye and produces a stable tear film that helps maintain clear vision.

But blinking also interrupts one's sight every 3 to 4 seconds. A person's blink rate is controlled by a combination of vision maintenance, cognitive state, psychological factors, and medical conditions.

When not timed correctly, blinking can lead to negative outcomes. For example, human micro expressions, or transient facial movements that reflect one's true feelings, last for only 160 to 500 microseconds and could be completely missed during a blink. To minimize any negative effects, many people temporarily modify or suppress their blinking, but it's difficult to measure those changes and their impact.

## Do Blinking Patterns Change While Driving?

Although people typically blink at random intervals, a recent study published in *iScience*

by cognitive neuroscientist Ryota Nishizono and colleagues found that isn't always true. A former professional cyclist, Nishizono was inspired by the lack of articles and studies about blinking behavior during cycling or motor racing and decided to investigate the topic himself.

For the experiment, eye trackers were mounted on the helmets of three Formula 1 drivers. The racers then completed a total of 304 laps on three Formula 1 circuits: the Fuji Speedway, the Suzuka International Racing Course, and Sportsland SUGO.

The drivers' blinking patterns were unexpectedly predictable. They avoided blinking when maneuvering curves or changing speed or direction and blinked more often and consistently on straight sections of the tracks.

## Findings and Future Studies

The results highlight the trade-off between keeping our eyes moist and maintaining vision during crucial tasks. Nishizono's group

identified three underlying factors for blink patterns: one's personal blink count, the lap pace and how closely it was replicated, and the acceleration associated with comfortable blinking. Their findings also suggest that blinking is correlated with one's changing cognitive state.

Blinking patterns while driving may be more obvious than those observed during passive tasks. Other factors like driver expertise, knowledge of the courses, the risk of fatality while driving, sensory information intensity, and active motor control also contribute but were not separately assessed in this experiment.

Next, Nishizono wants to further explore the processes that allow or inhibit blinking and how blinking behavior varies among the general population.

### DISCUSSION QUESTIONS

Can you think of other situations where changes in blinking patterns might be significant?

What other everyday activities can be affected by stress?

### VOCABULARY

MICRO EXPRESSIONS

FORMULA 1

COGNITIVE NEUROSCIENCE





# Could Bioelectronics Be the Future of Medicine?

By Kylie Wolfe

Would you let a tiny machine wander inside your brain or body if it could improve your quality of life? Although you may say no today, the evolving field of nanotechnology could change your mind—in more ways than one.

Researchers at the Massachusetts Institute of Technology (MIT), including nanotechnologist and assistant professor Deblina Sarkar, are taking the steps needed to turn what sounds like a science fiction concept into a real-world possibility.

## Merging Biology and Electronics

Researchers like Sarkar are looking to solve biological problems with electronics. Using nanotechnology, they may be able to help doctors find signs of Alzheimer's and Parkinson's diseases or other neurological troubles. Diseases like these affect millions of people globally, but their symptoms often stay hidden until it's too late to change course.

That's why super tiny electronic devices could help. Sarkar's hope is to find a way to send them marching into the brain someday, so they can detect and reverse devastating disorders that are otherwise permanent.

## An Ever-Changing Field

Existing bioelectronic implants are large and invasive, often damaging tissue and cells in their path. But, as Sarkar stated during a TEDx talk in Boston, her hope is that the field can eventually produce nanotechnologies that “match the size of biomolecular structures.” She goes on to say that “biomolecules are very fragile. And when their structures get disrupted, that leads to diseases.”

According to her presentation, her team at MIT is building transistors atom by atom. Their goal is to produce wireless, subcellular devices that can coexist with cells and not cause damage or disruption. But is it possible to stimulate the brain using something so small?

## Signs of Progress

Sarkar and her team would say yes, it is possible, because they've already created a device known as the Cell Rover that can monitor cells from the inside. As part of a study published in 2022, researchers positioned the device in a mature frog egg cell using magnetic fields and found that they could stimulate it at a safe frequency—meaning it could communicate with them.

With tiny technology, it's possible that scientists could one day locate abnormalities such as misfolded proteins in the brain, an early sign of Alzheimer's. The Cell Rover may also be able to pull energy from cells and stimulate them like an electrode or even become a go-to alternative for invasive surgeries.

No matter what the future holds, it appears that Sarkar will be leading the way. She has a lengthy list of inventions in the bioelectronics field, won an award from the University of California Santa Barbara for her work, and is one of ten scientists to watch in 2023 according to *Science News*.



### DISCUSSION QUESTIONS

What are a few other applications for microscopic machines in the world of medicine?

Make a list of the pros and cons of sending a tiny device into the brain or body.

### VOCABULARY

[NANOTECHNOLOGY](#) [BIOELECTRONICS](#)  
[NEUROLOGICAL](#)

# Pacific Ocean Is Home to Thousands of New Species

By Christina P. Hooton

It may be fun to speculate about the existence of life on other planets, but luckily you don't need to travel that far to find new life forms. Over 5,000 species have recently been discovered in a region of the Pacific Ocean called the Clarion-Clipperton Zone (CCZ), an area that spans almost two million square miles between Hawaii and Mexico.

According to a paper published in the journal *Current Biology*, this mineral-rich area of the ocean floor is home to thousands of marine species that are new to science—and potentially many more since the area is relatively understudied.

## An Ocean of Data

Synthesizing more than 100,000 records drawn from previous research expeditions, scientists developed the first exhaustive list of species known to exist in the CCZ. Of the 5,580 species observed in this study, 5,142 species are new and haven't been formally named and described, and little is known about them. Only six of the species scientists are familiar with are documented in other parts of the ocean.

The study focused on benthic metazoans, or multicellular animals living at the bottom of the ocean, a place of extreme cold and darkness with very little food. Scientists join research cruises to send remote-controlled vehicles over 13,000 feet below the ocean surface to study and collect these specimens, watching by video from the boat.

Most species in the CCZ are arthropods, worms, members of the spider family, and echinoderms. These alien-like creatures, some brightly colored with spiny tentacles like the deep-sea starfish and others eerily translucent and blob-like, such as the gummy squirrel, seem perfectly happy with life under the sea.

## A Threat to Biodiversity

The CCZ is not only attractive to the sea creatures who live there. It is currently being considered for deep-sea mining expeditions because of its high volume of mineral deposits. Small rocks called nodules about the size of a potato fill the seafloor and are rich with minerals such as cobalt, manganese, nickel, copper, and zinc. These minerals are valuable because they can be used to develop electric vehicle batteries and renewable energy.

"We are on the eve of some of the largest deep sea mining operations potentially being approved," study co-author Adrian Glover, a researcher at the Natural History Museum in London, said in a statement. "It is imperative

that we work with the companies looking to mine these resources to ensure any such activity is done in a way that limits its impact upon the natural world."

Some worry that the underwater vehicles used for mining could crush or disturb marine animals and release sediment that may be filled with toxic heavy metals. Until the full impact on biodiversity is understood, scientists are urging caution to help protect these spectacularly unique species from extinction.

### DISCUSSION QUESTIONS

What other ecosystems or areas of the world are relatively understudied?

Why is it so important to preserve the biodiversity of the ocean and other ecosystems?

### VOCABULARY

MARINE SPECIES ARTHROPODS

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# How Animal Hibernation May Help Us Explore Space

By Tom Wright

"Space, the final frontier." These words from the classic television show *Star Trek* immediately take science fiction fans on a ride through the cosmos. Sadly, a warp drive that can carry us across galaxies faster than the speed of light is beyond our current technology. But this doesn't dim our drive to visit and explore other planets; it's just not going to be a fast journey.

## Weighed Down

The closest stars with potentially habitable planets are approximately 20 light-years away. So, at near light speed, it would take over 20 years to reach one. Even a trip to Mars would take nine months—one way.

The basic need for food and water, in addition to other physical necessities associated with human space travel, would require a spaceship so large that it could never leave Earth. How can we overcome the basic needs of sustaining human life on these trips? The answer may be hibernation.

## Animal Inspiration

A common element of space travel in science fiction is a hibernation chamber or pod. Typically, it's a cylinder large enough to hold a person and deliver nutrients to them as they lie dormant for the months or years-it takes to cross the cosmos.

But is this feasible? Two lines of research into the animal kingdom are being explored to find out.

"I think this is realistic," said Katherine Grabek, biologist and co-founder of the company Fauna Bio, according to the article "Humans might be able to hibernate during space travel" from *Science News Explores*. "I think it would be done...by making ourselves as similar as we can to a hibernator."

One of those hibernators is bears. Part of a bear's hibernation process includes turning on and off specific genes that control fuel consumption and muscle strength. Humans have many of these same genes, and it may be possible to turn them on and off in humans to emulate the hibernation of bears.

Another option is to go beyond hibernation by freezing astronauts. But that's not so simple. If you fill a plastic bottle with water and freeze it, the bottle will burst because ice takes up more space than water. Cells in our bodies are mostly filled with water, so freezing could rupture them. Also, ice crystals can be jagged and possibly rip open cell walls.

A solution, however, may come from wood frogs in the Arctic. When they hibernate, they freeze 65 percent of their bodies, and combat the formation of ice crystals inside of their cells using glucose and urea. This enables them to thaw in warmer months without damaging their bodies. It may be possible to use chemicals to prevent the formation of potentially damaging ice in our bodies when they experience sub-zero temperatures, too.

## Still Searching

While we have not figured out how to safely freeze humans or use hibernation to support space exploration, further research could provide insights that lead to breakthroughs in cryobiology and eventually help pave our path to traversing the stars.

### DISCUSSION QUESTIONS

- What is the exact length of a light year?
- Name three physical changes that occur in animals when they hibernate.
- Describe what happens to cells when they freeze.

### VOCABULARY

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