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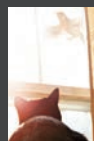
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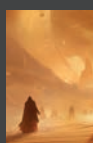
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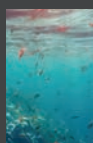
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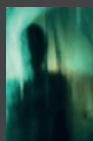
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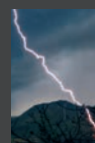
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Listen Up: Your Earbuds Could Be Harming Your Hearing

By Gina Wynn

Listening to music, podcasts, videos, and video games through earbuds and headphones has become a normal part of everyday life for many of us. But findings show that exposure to noise that's too loud for too long can affect our hearing.

Unrealized Risk

These devices have been gaining popularity, especially among children five to 12 years of age, according to a C.S. Mott Children's Hospital National Poll on Children's Health. The University of Michigan survey of 1,152 U.S. parents showed that around two thirds of them have kids who wear earbuds or headphones regularly. It also found that only about three out of five parents try to limit their kids' usage.

In fact, among all age groups, common usage of these listening accessories has been on the rise, according to a recent *Statista* report. Globally, 553 million pairs of headphones were sold in 2022, more than doubling the 286 million sales figures of 2013.

A Crisis for Children

Children's ears are especially vulnerable to damage because their ear canals are narrower. This can amplify sounds traveling to the inner ear. Excessive noise at over 70 decibels for preadolescents and 60 decibels for infants can also alter or even kill the delicate hairs in their ears, which vibrate when struck by sound waves. And they don't grow back, according to poll co-author and pediatric researcher Susan Woolford as reported by the *Scientific American* article "Most U.S. Children Now Use Headphones Regularly. Is Their Hearing at Risk?"

Over 1 billion youth and young adults ages 12 to 35 who engage in "unsafe listening practices" are at risk of permanent hearing loss, according to the World Health Organization. They also predict "disabling hearing loss" for 1 in 10 of us by 2050.

Avoiding Negative Outcomes

Not only can long periods of exposure at high decibels damage your hearing and cause tinnitus—a persistent ringing in the ears—it can increase your blood pressure, disturb your sleep, create stress, and impact your mental health. Excessive noise has also been linked to cardiovascular disease. The good news is that these outcomes are avoidable as parents and adult users become more aware of these hazards.

Woolford recommends following the "60/60 rule," which means that children engage in no more than 60 minutes of device use at a time at no more than 60 percent volume. Whatever your age, you can also help protect your hearing by setting a maximum volume limit on your phone and monitoring your listening time. You should also take advantage of the noise-canceling feature if your device offers it.

If you reduce background noise, you won't be so tempted to pump up your listening volume. This is not a good option if you need to be aware of your surroundings, however, like when you're crossing a street or riding a bike.

As the availability of digital entertainment options continues to expand, so will our dependence on earbuds and headphones. Raising awareness of their hazards and safe levels of noise exposure is crucial to protecting everyone's ear health.

DISCUSSION QUESTIONS

- How much time do you spend wearing earbuds or headphones and why?
- How can they be dangerous?
- How can you use them safely?

VOCABULARY

- DECIBELS
- TINNITUS
- PREADOLESCENTS





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Astronauts Take to the Desert to Train for Moonwalks

By Mark Miller

NASA astronauts visited a volcanic field in Arizona to rehearse how they will collect geological samples from the unexplored south polar region of the Moon. Their mission will be the first trip back there since Apollo 17 in 1972.

Nocturnal Navigation

According to the article “Exclusive: How NASA astronauts are training to walk on the Moon in 2026” published in the science journal *Nature*, these tests, known as Joint EVA and Human Surface Mobility Test Team or JETT5, took place during twilight and at night to mimic the shadowy world near the bottom of the Moon.

Their mission will be the first trip back to the Moon since Apollo 17 in 1972.

At such extreme latitudes, the angle of the sun creates sharply contrasting areas of light and dark, so a specialized spotlight or “sun cart” was positioned to simulate the light the sun would cast as it sits near the horizon. The astronauts navigated this dim, eerie setting to practice taking photographs and collect specimens assisted only by handheld lights and those attached to the helmets of their mock spacesuits.

It’s a tough environment, but the *Nature* exclusive reports that astronauts Kate Rubins and Andre Douglas did well. On one of their four walks, they moved ahead of schedule and were able to deploy drive tubes—metal cylinders driven into the ground—to bring back a core sample of eroded sediments.

Team Effort

JETT5’s acquisition of geological materials is highly coordinated. Mission control personnel and a scientific team located at the Johnson Space Center in Houston, Texas used real-time video to guide the moonwalkers—and that guidance is based on extensive research.

“We can’t just say we want that rock,” explained University of Texas at El Paso geologist José Hurtado in the *Nature* article. In working with the JETT5 team, he points out that “we have to elucidate why we want that specific rock and why it ties back to our priorities.”

JETT5’s goals are to study the processes of the lunar surface, determine the age relationships between its rocks and better understand its volcanic history, and discover whether there could be volatile elements frozen in the soil.

Volatile elements—or volatiles—are molecules that readily evaporate and turn into their

gaseous forms, including water and carbon dioxide. The International Space Exploration Coordination Group suggests that because of the way sunlight strikes the lunar poles, it can produce permanent shadows that trap volatiles. This means that the JETT5 team may discover further indications of the presence of water on the Moon and much more.

DISCUSSION QUESTIONS

- Name three advantages of using simulations.
- Why is a volcanic area a good place to simulate the Moon’s surface?
- Why do we only ever see one side of the Moon?

VOCABULARY

- LATITUDE LUNAR
- SEDIMENT CARBON DIOXIDE

Scrolling Through Life: Mitigating Social Media's Health Risks

By Kelley Northam

From Facebook to TikTok, social media connects us with people worldwide. But is this unlimited connection to others disconnecting us from the people around us? Is it even disconnecting us from ourselves?

Swipe Right for Risks

Educators, lawmakers, and doctors across the country are concerned with how cellphones are distracting children, with many pushing to ban cellphone use in schools. They note that levels of scrolling and streaming are causing serious disruptions to adolescents learning new things, creating healthy habits, and building relationships.

Even more distressing is the damage social media can cause to mental health. In 2023, the United States Office of the Surgeon General issued an advisory entitled *Social Media and Youth Mental Health*, citing a 2019 study published in *JAMA Psychiatric* by Kira Riehm, Kenneth Feder, and Kayla Tormohlen. These scientists concluded that adolescents who spend more than three hours a day on social media have double the risk of poor mental health outcomes, including symptoms of depression and anxiety.

In a 2024 *New York Times* opinion piece, the United States Surgeon General, Dr. Vivek H. Murthy, even called on Congress to require a

Surgeon General warning on all social media platforms. Akin to the cancer warning labels on cigarette boxes, this would alert all users that social media poses a risk to mental health.

Limiting the Unlimited

While these concerns are alarming, it can be confusing to determine how much screen time is too much. After all, we depend on phones for staying up to date, communicating with loved ones, and getting help in emergencies. Here are some phone best practices to help boost your focus and protect your mental health:

- **Restrict notifications:** When your phone buzzes, it's tempting to stop what you're doing and look. To minimize this, change your notification settings to stop receiving notifications from non-essential apps.
- **Stay active:** Exercise is good for the body and the brain. Take a walk or play a sport by yourself or with a friend and leave the phone behind to give your brain a boost.

- **Focus on bedtime, not screen time:**

Cell phones emit blue light, which hinders your brain's ability to produce melatonin—the hormone that helps you sleep. Avoiding the screen for at least an hour before bed can help you have a more restful sleep, so you're recharged and ready for the next day.

- **Reach out if you need help:** If

you feel like your mental health is suffering, talk to a trusted adult or get confidential help at [samhsa.gov](https://www.samhsa.gov).

With cellphones at our fingertips, it's easy to let social media get out of hand. But by taking more time to disconnect, we can reconnect with our friends, our interests, and ourselves.

DISCUSSION QUESTIONS

- What do you use your phone for the most?
- What are some ways that you can limit your social media usage?

VOCABULARY

[MENTAL HEALTH](#) [SOCIAL MEDIA](#)
[MELATONIN](#)

From Fowl to Feline: The Evolution of Bird Flu

By Christina P. Hooton

Although cats are said to have nine lives, that superstition won't protect them from a new potential health threat. The highly pathogenic H5N1 avian influenza has been infecting and killing cats, according to a *Science News* article. This latest strain of bird flu has been circulating since 2021, mostly affecting wild birds and poultry in the United States. Mammals have not been spared from the virus with reports of goats, dairy cattle, and alpacas falling ill as well.

Scientists can examine these latest developments to try to predict how the virus will evolve and determine whether it will ever mutate enough to spread between humans.

Look at What the Cat Dragged In

For outdoor cats who enjoy catching birds, this is bad news. Even if a cat doesn't consume wild birds, they can become infected just by coming into contact with them. And cats who are fed raw meat diets, particularly raw poultry, are just as exposed. Water, footwear, or equipment contaminated with bird droppings pose a threat, as well as raw milk that hasn't been pasteurized to kill bacteria and viruses.

There are no bird flu vaccines for cats, so prevention is the best medicine. Experts advise keeping cats inside and away from birds. They recommend cleaning shoes and disinfecting surfaces that come into contact with bird droppings. Symptoms to look for in cats include stiff body movements, wobbliness, circling, runny noses, and blindness.

Occupational Hazards

The Centers for Disease Control and Prevention (CDC) reports that sick animals may be able to transmit the virus to people via their saliva, feces, and other body fluids. When

the virus is inhaled or gets into a person's eyes, nose, or mouth, either by breathing in droplets or dust or touching something with the virus on it, an infection can occur.

This means people, especially veterinarians and other professionals, who come into contact with animals who are suspected or confirmed positive for H5N1 should take precautions.

An Evolving Situation

Currently, there is a low risk of pets, farm animals, or wild animals infecting people.

However, viruses mutate as they replicate. They make mistakes in the copies they create, leading to new variations in the virus's characteristics, such as transmissibility.

According to a May 2024 CDC report, the genetic sequencing of a bird flu infection in a Michigan dairy farmer showed that the virus had evolved to be more likely to infect humans, a sign that the virus is changing.

Although there's no indication that the virus is sophisticated enough to spread between humans yet, this is a situation health officials will certainly be monitoring.

DISCUSSION QUESTIONS

What factors contribute to a virus's ability to mutate and potentially spread between humans?

How can scientists and health officials effectively monitor and respond to changes in viruses like the H5N1 avian influenza virus?

VOCABULARY

PATHOGENIC INFLUENZA

VIRUS MUTATE

REPLICATE TRANSMISSIBILITY

Powering the Future Through Plants, Panels, and Pollinators

By Kelley Northam

From your first sip of morning coffee to your late-night bite of chocolate, pollinators such as bees and butterflies are crucial to the food we enjoy every day. In fact, one out of every three bites of food, such as fruits, vegetables, and nuts, was brought from the field to your plate by these insects. Across industries, busy bees bring in billions, as pollinators' annual ecological value is estimated at 200 billion dollars.

Unfortunately, pollinator populations and overall biodiversity have decreased due to habitat loss, pesticide usage, and climate change. However, researchers have begun to restore these insects' homes and fight climate change by building photovoltaic solar arrays on rehabilitated farmland.

Harvesting Sunlight and Data

Photovoltaic solar cells, also known as solar panels, convert sunlight to electricity and are a carbon-neutral energy source. Aside from sunlight, the main requirement of these panels is land, and lots of it. The United States Department of Energy's (DOE) Solar Futures Study estimated that approximately 10 million acres of U.S. land is needed by 2050 to achieve solar development, decarbonization, and climate change goals. Research has also revealed that former farmland is ideal for housing solar panels. These insights have created a unique opportunity to study how agricultural practices and solar energy production interact, also known as agrivoltaics.

Described in a press release on [anl.gov](https://www.anl.gov), researchers at the DOE Argonne National Laboratory and National Renewable Energy Laboratory planted native grasses and wildflowers at two southern Minnesota solar sites in early 2018 to further understand agrivoltaics. Operated by Enel Green Power North America,

both solar farms were built on retired agricultural land. They concluded their study in August 2022 and conducted a total of 358 observational surveys where they recorded and assessed changes in the abundance and biodiversity of flowering fauna and insects each visit.

Buzzworthy Breakthroughs

By the end of the study, all habitat and biodiversity metrics increased, including native plants and pollinators. There was also growth in the biodiversity of plants and insects such as honeybees, butterflies, beetles, and many more. Native bees increased 20-fold, and scientists observed these bees and other pollinators visiting nearby soybean fields, providing extra pollination.

These findings suggest a promising future for pollinators and restored farmland solar energy facilities and may even soothe concerns about the adverse effects of converting agricultural farms to solar farms. This study suggests that agrivoltaics can actually preserve farmland and make it more fruitful through additional pollination.

While more research is needed to confirm these conclusions, many scientists have already begun. In Georgia, land owned by former U.S. president and clean energy advocate Jimmy Carter has become a solar field that's also restoring pollinator habitats. While researchers have been focusing on

stormwater runoff and soil types, the pollinator population has flourished. SolAmecia Energy currently owns the land, and its vice president, John Buffington, noted that pollinator-friendly solar energy could change the industry. In the "Pollinator-Friendly Solar in Plains, Georgia" case study published on fresh-energy.org, Buffington stated that these sustainable practices also "help contribute to better management of a site by reducing the amount of our budget that goes to mowing and other maintenance."

Although there is more to discover, these agrivoltaic studies have revealed new ways to restore environments, reduce emissions, and fight climate change. By protecting pollinators and creating habitat-friendly solar fields, we can create a brighter future for insect-kind and humankind.

Originally published in Lab Reporter.

DISCUSSION QUESTIONS

Aside from solar panels, what are some other clean energy sources?

What are some ways that you can help build and protect pollinator habitats?

VOCABULARY

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Exploring Arrakis:

Could Humans Survive the Deserts of *Dune*?

By Kelley Northam

At the beginning of the 2021 blockbuster movie *Dune*, the character Chani says, “My planet, Arrakis, is so beautiful when the sun is low.”

While she already appreciates the stunning natural splendor of her home, outsiders Paul Atreides and Lady Jessica desperately try to survive the sweltering heat, sprawling desert, and gigantic sandworms that befall them in Arrakis.

While *Dune* is a work of science fiction, it has made scientists ponder whether a civilization could survive and thrive on a planet like Arrakis. Could humans withstand the dangers of the Arrakis sun long enough to experience its beauty?

A Sandy Simulation

Climate scientists Alex Farnsworth, Michael Farnsworth, and Sebastian Steinig decided to find out by creating a computer simulation of the fictional planet. In 2021, they started their work by inputting data into a climate model typically used to forecast the Earth’s weather and climate patterns. The model analyzes variables such as the laws of physics, topography, and atmosphere.

The team assumed that Arrakis would share the Earth’s fundamental physics laws, but they gathered most of their information from the lore in the *Dune* novels by Frank Herbert and *The Dune Encyclopedia* by Willis E. McNelly. One of the most notable differences between Arrakis and Earth is the lower atmosphere’s ozone level. On Earth, the ozone concentration is 0.000001 percent, while on Arrakis, it is 0.5 percent. The higher the ozone level, the more heat air can retain.

It’s Plausible for Paul

After over three weeks of computer calculations, the team reached an exciting conclusion: humans could survive on Arrakis. According to the model, temperatures around the planet’s equator would range from about 113°F in the warmest months to about 59°F in the coldest ones. While extreme heat can be unpleasant and dangerous, populated areas of Mexico, India, and other regions consistently experience temperatures of over 113°F.

However, the simulations also suggest that some areas would be uninhabitable. In the mid-latitude regions, areas lying between

30° and 60° of the equator, summers could be a scalding 158°F, and polar areas could be as frigid as –103°F. Advanced technologies in the *Dune* universe, like “Stillsuits,” which keep wearers cool and hydrated by recycling bodily moisture, could help people survive in these areas. However, in the real world, no such technology currently exists, rendering these regions uninhabitable.

If humans ever ventured to a real-world Arrakis, we’d have more reason to fear the sun than sandworms. But if we took the proper precautions and stayed within specific regions, we might be able to marvel at the sun sinking below the dunes.

DISCUSSION QUESTIONS

What are some other factors that could affect a planet’s climate?

What’s an invention you’d create that would help people survive extreme heat or cold?

VOCABULARY

EQUATOR OZONE

ATMOSPHERE SCIENCE FICTION



Two New Materials May Help Halt Microplastic Pollution

By Mark Miller

The U.S. National Oceanic and Atmospheric Administration (NOAA) defines microplastics as pieces of plastic less than five millimeters in length. The agency's web page adds that they are "the most prevalent type of marine debris found in our oceans and Great Lakes."

Once microplastics get into the water, it can take hundreds or thousands of years for them to decompose. There is evidence, according to information from the University of Plymouth, that microplastics could harm birds and marine animals that may mistake them for food.

And microplastics aren't only found in water. Based on reports from *Science News Explores*, they're in the air, in soil, food, and even human blood. But two new materials may help slow their spread.

Preventative Potential

The article "Scientists Have Created Synthetic Sponges That Soak Up Microplastics," published in *Smithsonian Magazine*, describes a new sponge that can absorb up to 90 percent of microplastics in seawater and tap water.

Researchers in China have developed a sponge so light it can be balanced on the petals of a flower. When a plastic-filled liquid is forced through it, it filters out microplastics and smaller nanoplastics. The sponges were created using mainly starch and gelatin, both biodegradable substances.

Potential applications vary from wastewater treatment to food production, but the key, explained chemist Anett Georgi from the Helmholtz Center for Environmental Research in Germany, is capturing microplastics before they enter the environment through water. Microplastics can find their way into water in different ways—when synthetic fabrics are washed, as microbeads that are part of health and beauty products, or simply from discarded pieces of plastic that degrade into smaller fragments.

Once in the water, they may be impossible to remove. "We have to stop it getting there in the first place," she said in the article.

Algae-Based Meal for Microbes

What may be an even better way to reduce microplastic pollution is to engineer new plastics that break down more quickly than those commonly used today. That's what Michael Burkart, a biologist at the University of California San Diego (UCSD), and his company, Algenesis Materials, are doing.

"To limit pollution, new recipe makes plastic a treat for microbes," published in *Science News Explores* reports that Burkart and his team have developed a type of biodegradable polyurethane made from plants and algae. These plant-based building blocks, called esters, can be broken down and eaten by microbes.

The team compared how quickly the new material might break down by comparing it with ethyl vinyl acetate, or EVA, made from fossil fuels. First, they mixed the microplastics in a compost of plants, food waste, and microbes. When they checked the breakdown levels after 90 days, they found that 68 percent of the plant-based plastic had broken down. After seven months, according to the article, the level rose to 97 percent, while there was no sign of EVA breakdown in that time.

More Work for Less Microplastic

As research progresses, each of these technologies faces significant challenges and opportunities. For the sponges, demonstrating that they can be cost-effective in filtering microplastics on a large scale is key. The team at Algenesis Material is looking for ways to manufacture biodegradable, single-use plastics based on their algae-based polyurethane.

DISCUSSION QUESTIONS

Can you name three commonly used plastic items that might contribute to the spread of microplastics?

What are two things you can do to limit your use of plastics?

What does it mean when something is biodegradable?

VOCABULARY

NANOPLASTIC STARCH

ALGAE MICROBE



A Glowing Legacy: The Radium Girls

By Celeste Beley

From population growth to the development of the automobile and increased factory outputs in the early 1900s, there were signs of progress in the United States. But sometimes, new ideas and innovations have consequences that stay hidden until it's too late.

Radioactive items, for example, were trendy in the early 20th century as companies touted radium-laced toothpaste, hair cream, cosmetic spa treatments, and even water as a way of healing cells and tissues. Once the adverse health effects were discovered, those products quickly fell off the market.

For one group of young women, now referred to as the Radium Girls, uncovering the downsides of radium exposure came at the cost of their health.

Radium Explored

Radium was discovered by Marie and Pierre Curie in 1898. Radium is the heaviest known alkaline earth metal and is the only radioactive member of its group.

Throughout the 1900s, radium was used in various cancer treatments. While successful at shrinking tumors, exposure led to harmful side effects such as anemia, new cancers, and genetic mutations. Research into using radium as a cancer treatment continued into the 1960s, but its use largely declined after 1935. Today, radium is still used in some treatments, but with safer and more available isotopes.

The Ghost Girls

In 1917, the United States Radium Corporation (USRC) became a major supplier of radio-luminescent watches for the military. USRC hired workers to paint watch faces with radium, primarily young women whose small hands were ideal for the tedious work. They would use camel-hair brushes to apply the paint to the watch face. The brushes would lose their shape after a few applications, so workers were instructed to use their lips or tongue to keep their brushes sharp, ingesting radium each time they performed this task.

Owners of the company and scientists who were familiar with radium avoided exposure in the laboratory, using lead screens, tongs, and masks to handle the material. That information was not shared with those working in the factory. The women used the paint on their own teeth, nails, and faces and dust would accumulate on their clothing. As a result, they would glow green at night, earning the nickname “ghost girls.”

Illness Revealed

It did not take long for these young watch painters to suffer serious symptoms. One of the first, Amelia Maggia, presented with a toothache, requiring an extraction. Soon, additional teeth needed to be pulled, but instead of healing, painful ulcers developed where the teeth were. Maggia's symptoms continued to spread throughout her jaw, neck, and body. Her jaw had to be removed and she ultimately died from a massive hemorrhage on September 12, 1922. Doctors, still unaware of the side effects of radium exposure, incorrectly listed her cause of death as syphilis.

Other girls continued to become deathly ill, developing the same symptoms as Maggia. Despite this, USRC and other manufacturers continued to insist that the process was safe and denied responsibility for their deaths. When public pressure finally led to a downturn in sales, the company commissioned an independent study to determine any correlation between radium paint and the girls' symptoms.

Dr. Harrison Martland conclusively found that their symptoms were indeed from radium poisoning—the ingested radium was emitting constant radiation that essentially destroyed their bones and tissues from the inside out. The company refused these results and completed additional studies that claimed the radium paint was safe. They leaned on health providers who claimed that the symptoms were instead a result of sexually transmitted diseases.

Fight for Justice with Science

Grace Fryer, a watch painter in Orange, New Jersey, decided to sue the company in 1925, but it took two years to find a lawyer willing to take the case. She was joined by Edna Hussman, Katherine Schaub, Quinta McDonald, and Albina Larice—the Radium Girls. The USRC used tactics to delay the trial, and since most of the girls had only months to live, they were forced to accept a settlement of \$10,000, plus payments for doctors' bills and a yearly pension of \$600.

At the original Radium Girls trial, Raymond Berry, their attorney, enlisted the expertise of Elizabeth Hughes. At the National Bureau of Standards (now the National Institute of Standards and Technology), Hughes calibrated sealed radium sources using a gold-leaf electroscope. In a lead-lined chamber, gold leaf was suspended from a metal rod. When voltage was applied to the electroscope, the leaf accumulated charge and tilted relative to its original position. When a small amount of

radium was placed at a fixed distance, gamma radiation would enter the chamber and ionize the air. The electroscope discharged and the leaf returned to its original position. The faster the leaf moved, the more radioactive the sample was.

Hughes had also worked at USRC where she measured the amount of radioactivity in paint samples. She used the same electroscope procedure to measure breath samples from the Radium Girls, determining that they had ingested enough radium to make their breath toxic. At the trial, she testified that all workers should be protected from radium exposure and that most research institutions had already implemented safety measures to protect workers.

Additional lawsuits continued to be filed against watch manufacturers in New Jersey, Illinois, and Canada. A significant number of these settled out of court.

A Glowing Legacy

The legacy of the Radium Girls is important because they filed one of the first lawsuits against an employer for health and safety reasons. The public outrage over the lawsuits led to proper safety precautions and safety gear use in the watch plants, where radium was still used into the 1970s. Additional occupational labor laws were enacted and eventually led to the establishment of the Occupational Safety and Health Administration (OSHA).

DISCUSSION QUESTIONS

Explore how radium changed the world in a positive way. Do you feel it was worth the sacrifice?

Besides radium, what other world-altering discoveries can you think of that led to both advancement and tragedy?

How do you think today's world would be different had the Radium Girls not fought back against their company?

VOCABULARY

ISOTOPES RADIOLUMINESCENCE

ELECTROSCOPE



"Radium Girls" working at a United States Radium Corporation factory, c. 1922



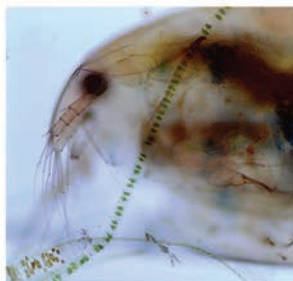
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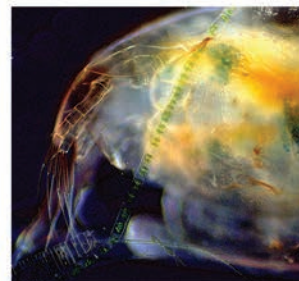
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Fact or Fiction: The Science Behind Ghosts

By Christina P. Hooton

A phantom voice, the presence of a translucent figure, and the unexplained movement of objects are all depictions of ghosts from people who claim to have encountered them. Research suggests that many people believe in ghosts. According to a *Science News Explores* article, a Pew Research Center survey reported that one in five people in the United States said they've seen or been in the presence of a ghost.

While there is little evidence to support this, there are scientific explanations for what people experience when they see a ghost. Whether you're convinced of their existence or you're a firm believer in the scientific method, you'll be fascinated by these real-world phenomena.

Life-Like Dreams

Have you ever woken up from sleep unable to move or speak? You may also see or hear figures that aren't really there and feel frozen in place. If so, this is a common occurrence called sleep paralysis.

Dreaming is supposed to happen when we are fully asleep and is most vivid during rapid eye movement, or REM sleep. This is the stage of sleep when your eyes dart around under your eyelids, but the rest of your body is paralyzed.

It's your brain's job to turn off this paralysis before you awake. When that doesn't happen, sleep paralysis occurs. The apparitions you are seeing may seem life-like, but they are just hallucinations.

Fascinating Hallucinations

Hallucinations can haunt us when we're awake, too. You may have sensed the presence of something that is not there—laughter in another room, a figure in the shadows, or a creaky door.

As your brain engages in bottom-up processing, that is, perceiving sensations around you, it sometimes finds meaning in meaningless things. This is also known as pareidolia. It's why we see rabbits or faces in the clouds.

These misperceptions can also be chalked up to your brain filling in the missing parts as it performs top-down processing. There is usually too much information coming from the world around you for your brain to process it all at once, so it parses out the most important information and fills in the rest. Sometimes, your brain adds things that aren't there, like when you mishear song lyrics, and it fills in the wrong words.

Mind Games

Your brain can also miss things that *are* really there. Maybe you're making a sandwich in the kitchen and notice your basement door is suddenly ajar. Was it a ghost? Or were you so absorbed in your lunch preparations that you failed to notice your sister walk through the room and open the door?

Inattention blindness occurs when you are so focused on a task that you tune everything else out and completely miss something that is there.

Indeed, there is some spooky stuff happening here. But if we've learned anything, it's that we have nothing to fear and everything to gain when it comes to better understanding our brains and our perceptions of the world around us.

DISCUSSION QUESTIONS

Have you ever had the feeling that you encountered something supernatural, like a ghost? Gather more evidence from your experience and try to determine a scientific explanation for what was really happening.

What process would you use to either prove or disprove the existence of ghosts? Describe the steps you would take using the scientific method.

VOCABULARY

PHANTOM TRANSLUCENT

SCIENTIFIC METHOD PHENOMENA

PARALYSIS HALLUCINATION

Dry Farming

Could Be the Key to More Sustainable Agriculture

By Gina Wynn

Growing fruits and vegetables and raising livestock requires a lot of water. On average, farms account for 70 percent of our global water usage annually, and in California—where a third of U.S. vegetables are grown—agriculture accounts for around 80 percent of the water usage.

A Greener Alternative

As temperatures rise and western states experience more water shortages and droughts, farmers are looking to dry farming as a more environmentally responsible way to grow produce.

Dry farming still involves water, but it doesn't rely on the traditional irrigation methods of delivering water to crops above ground via pipes, canals, and sprinklers. Instead, dry-farmed plants rely on underground moisture stores for sustenance. For dry farming to work, you need to plant in an environment with a rainy season followed by a dry season. First, rainwater needs to be able to soak into the soil so when the land dries out, plant roots can find and suck up moisture as needed from below ground.

A Wise Choice in the West

Conditions are right for states in the western U.S. to practice this type of agriculture. Farmers in California and Oregon have already seen success with harvests of tomatoes, potatoes, squash, corn, watermelons, and more, according to the *Science News* article “Dry farming could help agriculture in the western U.S. amid climate change.”

Some benefits of dry farming include that it drastically cuts down on water usage at a time when erratic weather patterns are being linked to climate change. Farmers not only save on water bills, they also avoid having to purchase supplies like sprinklers, drip tape, and hosing—often made of plastic—which only gets used for a couple of seasons.

Financial Benefits and Better Flavor

Dry farming also enables farmers to use land in areas without irrigation that may have otherwise remained unplanted. And without irrigation, less weeds grow. Weeds thrive in traditional farming conditions because seeds that live in the top few inches of soil feed on the moisture that pools during above-ground sprinkling. Less of a need for weeding can also cut labor costs.

Because dry-farmed produce contains less water, it also lasts longer. This enables farmers to sell fruits and vegetables during the slower winter seasons and results in less food waste. The lower water content also contributes to a richer taste because it doesn't dilute the complex flavors acquired from minerals accessible in the deeper soil.

Smaller Harvests, Higher Prices

Dry farming is not without drawbacks, however. Crops require more space to grow because they need to be planted at distances where they won't have to compete for water. For example, tomatoes need to be placed nearly 21,528 square feet apart for dry farming, where they only need around 23.6 inches of separation and 3.281 feet between rows on irrigated farms.

Their absorption of less water also results in smaller-sized produce, which may not be as desirable to shoppers, and smaller harvests drive prices higher.

In our market economy based on supply and demand, widespread adoption of dry farming may not be practical. However, it still may prove a wise investment for environmentally conscious, small-scale fruit and vegetable growers, especially in areas where water resources are scarce.

DISCUSSION QUESTIONS

Where are people most likely to benefit from dry farming?

Why might states like California be experiencing droughts?

VOCABULARY

IRRIGATION

MARKET ECONOMY



Upcycle Your Favorite Veggies

Food waste is a significant problem and contributes to global warming around the world. With this in mind, it's important to make the most out of your produce. Here are some instructions for growing some of your favorite vegetables by upcycling vegetable cuttings and plastic bottles.

Materials

- Scrap vegetable(s)
 - Green onion (white part with roots attached)
 - Basil, cilantro, or mint leaf with 2 to 3 in. of stem
 - Celery, lettuce, cabbage, or bok choy stump
- Glass cup or bowl big enough to contain your vegetable cutting
- Toothpicks
- An empty 16 oz. water bottle or 2-liter soda bottle depending on the size of your vegetable (herbs, small lettuces, and baby bok choy can be grown in a 16 oz. water bottle; larger lettuces, celery, and bok choy should be grown in a 2-liter bottle)
- Scissors
- Hammer and nail
- Potting soil
- Masking tape
- Craft paint and paint brush

For a hanging planter:

- Hole punch
- Yarn, string, or ribbon

Instructions

Initiating growth of your vegetable

1. Add several inches of water to your glass or bowl.

Important: If using tap water, let it sit out overnight to allow any chlorine in the water to evaporate.

2. Place the vegetable cutting so that the bottom of it is completely submerged in water but not touching the bottom of the glass or bowl. For larger vegetables, pierce the vegetable cutting horizontally with a toothpick on 3 to 4 sides in order to suspend the vegetable in the water.

3. Place your glass or bowl in direct sunlight for approximately 1 week. During this time, you should observe new leaf and/or root growth. When the leaves/roots are a few inches in length, it is time to transfer your vegetable to soil.

Making your upcycled planter

1. Cut your water bottle in half with scissors.

Optional: To make a hanging planter, punch holes in the top half of the bottle on opposite sides and thread a piece of string, yarn, or ribbon of the desired length through both holes. Tie the ends together.

2. Remove the cap. Place a nail in the center of the cap and hit it with the hammer to create a hole in the cap. Put the cap back on the bottle.

Optional: Decorate your planter by first wrapping masking tape around the top half of the water bottle approximately $\frac{1}{4}$ of the way below the cut edge, then painting the section of the bottle from the tape to the top of the bottle (including the cap if desired). Allow paint to dry.

3. Flip the top half of the bottle upside down and fill $\frac{3}{4}$ of the way with potting soil (up to the line of paint if you painted it).
4. Place the top half of the bottle (cap side down) into the bottom half of the bottle so that it stands on its own.

Transferring your vegetable to soil

1. Create a 1 to 2 in. depression in the top of your soil to accommodate the roots of your vegetable.
2. Place the vegetable in the soil with the roots facing downward.
3. Add additional soil to cover the roots and pat down until the plant can stand on its own.

4. Add water until you see it drip through the cap into the bottom reservoir.
5. Water regularly and watch your vegetable grow. Remember to keep it in an area with good sunlight.

Understanding the Science

Plants are an important source of nutrients and energy for humans and animals. Ensuring our communities have an adequate food supply is a constant challenge for farmers around the world. In order to work together to meet the global demand for produce, farmers need to evaluate the available resources before determining which crops to raise in their region.

Scientists can assist farmers by helping them test their soil composition to determine available nutrients and ensure their crops are free of harmful bacteria. Additionally, scientists can help farmers reduce the use of pesticides, decrease water needs, and increase crop yield and quality through genetic engineering.

Originally published by the Thermo Fisher Scientific Corporate Social Responsibility team.

DISCUSSION QUESTIONS

How is it possible for a new vegetable to grow from just a cutting?

Why is it important to use potting soil?

VOCABULARY

UPCYCLE CUTTINGS

NUTRIENTS



Ink Masters and Archaeologists Team Up to Investigate An Iceman's Tattoos

By Mark Miller

Tattoos are becoming more and more popular, but they're nothing new. A *Science News* article, "How Ötzi the Iceman really got his tattoos," explains how tattoo artists are working with scientists to understand how tattoos were created thousands of years ago.

Meet the Inked Iceman

Ötzi is an approximately 5,200 year-old human who was discovered in the Italian Alps in 1991, according to *Science News*. His naturally mummified remains have 61 tattoos—crosses and black lines on his lower legs and back, left wrist, and chest.

Initially, experts thought that these body decorations were achieved by cutting into Ötzi's skin using a stone knife or tool and then rubbing charcoal ash into the incisions. But research conducted by prehistoric archaeologist Aaron Deter-Wolf of the State of Tennessee Division of Archaeology in Nashville is uncovering a different approach. "Our study shows that the past 30 years of conventional wisdom as to how the Iceman was tattooed is incorrect," he said in the article.

Ouch

To learn more about the process, Deter-Wolf worked with two professional tattooists. One of them, Danny Riday of The Temple Tattoo in Tamahere, New Zealand, was willing to tattoo one of his own legs using traditional techniques to compare his tattoos with those on Ötzi.

Riday set to work with instruments of bone, obsidian, and copper, as well as a boar tusk and a steel needle. He created a set of designs consisting of lines and filled-in triangles by hand-poking—tapping one end of a bone needle to puncture the skin with the pigment-covered point of the other. He also sliced his skin and rubbed in color and drew a color-infused needle through the outer layer of his epidermis.

New and Old

After Riday's markings had healed (six months later), Deter-Wolf and two other archaeologists compared microscopic images of them to ultraviolet and high-resolution digital images of the Iceman's tattoos.

Tattoos made with different tools and techniques show distinct physical signatures, Deter-Wolf explained in the *Science News* piece, which notes that the markings on Ötzi display stippling and rounded ends, and feature irregular seepage of color around the edges. These characteristics are associated with the hand-poking method using a bone point or copper awl—one of the procedures employed by Riday.

In a report from CNN, "Ötzi the Iceman's 61 tattoos weren't made in the way archaeologists first thought," Marco Samadelli, senior researcher at the Institute for Mummy Studies at Eurac Research, said that Deter-Wolf and team "do not claim with absolute certainty the puncture tattoo technique with a single-pointed instrument, but give extensive and plausible explanations." To further the research, next steps may include closely examining a bone awl and antler tip that were uncovered with the Iceman.

DISCUSSION QUESTIONS

- What health risks are associated with getting a tattoo?
- How did Ötzi die?
- Discuss whether the research done with Ötzi involves a comparative experiment.

VOCABULARY

- PREHISTORIC
- EPIDERMIS
- ULTRAVIOLET
- AWL

An AI depiction of the Iceman, a man who lived approximately 5,200 years ago in the Alps

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Warmer, Wetter Climate to Impact Thunderstorm Intensity

By Kylie Wolfe

Previous studies have discussed how a warmer climate will impact the continental United States, revealing that a continued rise in both temperature and precipitation may cause thunderstorms to increase in intensity.

As tropical storms make landfall and other extreme weather makes the news, understanding the science behind these forces may shed light on what's to come.

Forecast the Future

One study conducted at Colorado State University in 2017 produced detailed simulations of future weather patterns using the Weather Research and Forecasting model developed by the National Center for Atmospheric Research (NCAR) in Boulder, Colorado. They kept the natural environment in mind, including cloud processes and topographical features, which allowed for more accurate results across the entire country.

The researchers' forecasts showed that weak-to-moderate thunderstorms would decrease in frequency as intense storm systems became more common. The resulting increases in rainfall, lightning, and strong winds can ultimately contribute to more flash floods, fires, and tornados.

Scientists attribute these projected weather patterns to changing thermodynamic conditions. Warmer, wetter weather increases

the amount of energy in the atmosphere, and consistently warmer temperatures will maintain that high level of energy and release it in the form of severe thunderstorms. Maintaining this energy balance is what drives different weather patterns.

For example, because warmer air holds more moisture, climate change can produce more intense storms that carry larger amounts of rain.

But how these findings translate into what happens in the real world may need further exploration.

A Perfect Storm

A new study published in *Nature Climate Change* in 2023 assessed thunderstorm winds, specifically straight-line winds, and the damage they're causing. According to the research, these winds have increased in the central United States over the past four decades.

In the past, it was much harder to study these hazards, but modern technology is making it possible to consider tornados, hail, and other storm types. Even still, weather can be unpredictable.

"Wind is something extremely difficult to assess and is the peril we probably know the

least about in terms of potential change due to anthropogenic warming," Victor Gensini, professor of meteorology at Northern Illinois University, told *The Washington Post*.

Moving forward, it's important that scientists continue to assess the physical processes of clouds to better gauge the consequences of climate change. Meanwhile, researchers can conduct further simulations and create computer models to gain more insights about general weather and storm patterns.

DISCUSSION QUESTIONS

Define climate and weather and explore how they differ and how they're related. Write a sentence using each word to describe what's happening outside your classroom.

How do changes in temperature impact the weather and climate we experience and the thermodynamics of those systems? Discuss the Laws of Thermodynamics and apply them to variations in weather and climate.

VOCABULARY

CLIMATE WEATHER THERMODYNAMICS

Bacteria-Killing Plastics

Arise to Fight Infections in Hospitals

By Mike Howie & Mark Miller

When you're sick and go to the hospital, you expect to get better, but that's not always the case. The online research news resource *ScienceDaily* reports that 20 percent of patients that were hospitalized due to COVID-19 actually contracted the disease while in the hospital.

Illnesses like COVID-19 may spread in places thought to be exceptionally clean because of the ability for the bacterial microorganisms that can cause them to survive on plastic surfaces—which are practically everywhere in hospitals. According to *ScienceDaily*, “microorganisms can survive and remain infectious on abiotic surfaces, including plastic surfaces, for extended periods, sometimes up to several months.”

Two materials have been developed that may help shorten the lives of these germs. One is a coating developed at the University of Nottingham's School of Pharmacy in the U.K. The other is a plastic developed by chemist Ethel Koranteng and a research team at University College London.

Uncommonly Effective

The scientists in Nottingham coated a polymer called acrylonitrile butadiene styrene (ABS) with chlorhexidine, a disinfectant and antiseptic commonly used by dentists. What they discovered was an uncommonly effective method for eliminating infectious microbes.

The researchers examined the coated ABS using Time-of-Flight Secondary Ion Mass Spectrometry (TOF-SIMS), a method that uses light to see what's happening at the molecular level. It showed that the ABS not only killed microbes quickly, but after 45 minutes, the tested surfaces remained germ free. The coated ABS also worked for SARS-CoV-2,

the virus that causes COVID-19, leaving no viral particles after 30 minutes, according to *ScienceDaily*.

In addition, the coating may help combat antimicrobial resistance—where bacteria can change over time and no longer respond to antibiotics. “This research offers an effective way to do this and the material could be added to plastic materials during manufacture, it could also potentially be used as a spray,” said study leader Felicity de Cogan, PhD, in the report.

Fighting Germs with Light

An article published in *Science News Explores*, explains that Koranteng and her team also used a common material—polyurethane. But the important part is what's inside. The polyurethane is embedded with tiny semiconductor nanobits called quantum dots and a light-sensitive dye called crystal violet. Together, they use light to create a high-energy oxygen molecule that works as a potent antibiotic.

They tested their surface with impressive results. It killed 99.97 percent of the

methicillin-resistant *Staphylococcus aureus* (MRSA) bacteria, which is immune to the antibiotic methicillin, and it did nearly as well at destroying another antibiotic-resistant bacteria, *Escherichia coli* or *E. coli*, according to *Science News Explores*.

Both team's inventions could potentially reduce the risk and frequency of infections acquired in hospitals, which would make a meaningful difference in the lives of patients and doctors around the world.

DISCUSSION QUESTIONS

Where else might materials like these prove beneficial?

What are some other ways for hospitals to reduce the risk of infections?

What branch of science deals with diseases?

VOCABULARY

ANTIBIOTIC ABIOTIC

BACTERIA POLYMER

VIRUS



Promoting Equitable STEM Education

The demand for employees with strong science, technology, engineering, and math (STEM) backgrounds continues to grow, but today's students don't have equal access to high-quality STEM education. Since 2016, Thermo Fisher Scientific and Boys & Girls Clubs of America have partnered to support a 21st-century STEM workforce that reflects our society and leverages diversity to solve the world's most complex problems. The programs include the expansion of Boys & Girls Clubs of America's DIY STEM Program and the launch of STEM learning and training experiences for Club staff to spark youth interest in STEM fields.

Meeting Needs with DIY STEM Digital Platform

DIY STEM is Boys & Girls Clubs of America's hands-on, activity-based STEM curriculum for young people from ages nine through 12. Thermo Fisher Scientific has helped create and distribute DIY STEM kits with activities that

demonstrate everyday science concepts and personal protective equipment (PPE) for safe scientific exploration. During the COVID-19 pandemic, the curriculum moved to MyFuture, the Clubs' digital platform, and Thermo Fisher Scientific pledged to develop and support content, events, and competitions to help connect youth to STEM professionals with similar backgrounds and relevant career experiences.

Creating Strong STEM Educators

Great STEM programming starts with great STEM educators. In 2021, Thermo Fisher Scientific sponsored Boys & Girls Clubs of America's participation in a training series with targeted resources to build essential STEM knowledge and activity facilitation skills. This training and engagement makes age-appropriate and culturally relevant programming accessible to all Club members.

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Living in a Materials World:

How Material Scientists Are Forging a Sustainable Future

By Kelley Northam

From a smartphone in someone's pocket to a pacemaker in someone's chest, critical raw materials like lithium, cobalt, and heavy metals are essential for powering the technology we rely on today. However, despite the rising global demand, socioeconomic, geopolitical, and supply chain barriers are preventing many people from getting the critical raw materials they need when they need them. And as alarming climate change research continues to emerge, the world is looking for new methods to sustainably and ethically source and create safer products for consumers and the environment.

To address these barriers, material scientists around the globe are forging sustainable, innovative paths forward. They're developing better ways to process and refine critical materials and feed the innovation of novel materials and new products for a better future.

To support scientists in their materials transformation quest, the Biden-Harris administration designated 31 U.S. Tech Hubs in October 2023 as part of the bipartisan CHIPS and Science Act. These Tech Hubs are regions located across 32 states and Puerto Rico that have the capacity, infrastructure, and desire to host businesses that manufacture, commercialize, and deploy new technology.

With the help of funding opportunities, these Hubs can support domestic manufacturing by catalyzing growth in industries such as biotechnology, semiconductor manufacturing, and clean energy advancement. This will help intentionally innovate new methods for sourcing and using critical raw materials.

One recent innovation was spearheaded by Paul Canefield, a physicist from Ames Laboratory in Iowa, who developed a safer, greener, and more accurate method for characterizing new materials. Growing known and unknown compounds, referred to as solution growth, requires crucibles, which are heat-resistant ceramic containers in which the elements of the desired compound are combined. Traditionally, silica wool is used in crucibles as a filter, but it can lead to leakage, chemical contamination, and unwanted growths. It can also never be analyzed or reused.

To overcome these problems, he designed a strainer that separates crystal materials from their chemical solutions, resulting in a less wasteful and more economical technique for growing compounds. This technique is more efficient, more economical, and greener, advancing the materials discovery field and circular recycling.

Sustainable materials breakthroughs are also happening worldwide. At the University of Sydney, Australia, Professor Kourosh Kalantar-Zadeh and Dr. Junma Tang developed a method to help green chemical engineering, publishing their findings in *Nature Nanotechnology*. Typically, producing chemicals requires high amounts of energy and heat—up to 1,000°C—to melt solid metals. These scientists determined that liquid metals can also produce chemicals with less heat and energy, melting at only 30°C—a temperature that a gas cooktop could produce.

Reducing the energy required to produce chemicals is a huge step in greening the chemical manufacturing industry, which currently accounts for approximately 10 to 15 percent of overall greenhouse gas emissions. This new technique will help reduce energy and emissions while still supplying high-energy fuels, such as propylene, that are critical to many industries.

These are just a few of the many examples of how agencies, engineers, and researchers alike are paving new, suitable ways forward. Now's the time—**[browse our wide selection of testing and safety products](#)** to start innovating today to create the products of tomorrow.

Originally published in Lab Reporter.

DISCUSSION QUESTIONS

What are some other objects or devices that use critical raw materials?

What are some ways that you can support sustainability efforts?

VOCABULARY

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