

UnEarthed

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magic!



UNIVERSITY OF
PENNSYLVANIA



Letter from the Editors

Dear Readers of UnEarthed,

Our names are Daphne Cheung, Editor-in-Chief, and Chloe Gong, Managing Editor. On behalf of our executive board and our amazingly talented team of writers, editors, and designers, we are thrilled to present to you the second issue of UnEarthed! We are a group of undergraduate students at the University of Pennsylvania studying everything from Biology to English to Architecture to Dinosaurs. With our diverse, educational backgrounds, we have loved putting together this magazine.

Our team grew up on nostalgic goodies like Bill Nye the Science Guy and National Geographic KIDS, but we noticed that there aren't as many resources like these anymore. Whether it's chemical reactions, the mysteries of time travel, or the old ruins of Egypt, being inspired by fun, short, educational pieces is its own sort of magic. So the theme of this issue—magic—was inspired by the goal of UnEarthed. As we said in the first issue, we want to continue inspiring you to seek out your passion. What's more, we want you to delve into the unknowns of this world and find a sense of wonder, a feeling of magic. We want UnEarthed to be a resource that not only educates you about the coolest, wildest features of our wonderful home planet, but one that also whisks you away into the depths of your imagination and enthusiasm for learning.

It was a joy for us to put together this issue of UnEarthed for you, and we really hope you enjoy flipping through the pages and marveling at the artwork. Each issue we put out will feature a different theme, so be on the lookout twice every year to learn more and more about our world. And if twice every year sounds like too long of a wait, amazing news: UnEarthed has also recently kickstarted a digital branch too! Visit www.unearthedpenn.com to explore digital-only articles, fun quizzes, and informative videos—all uniquely made by our amazing Digital team especially for you!

As always, please let us know if you have any suggestions to improve the publication or artwork that you would like to see published in future issues. We hope you enjoy!

Daphne Cheung
EDITOR-IN-CHIEF

Chloe Gong
MANAGING EDITOR

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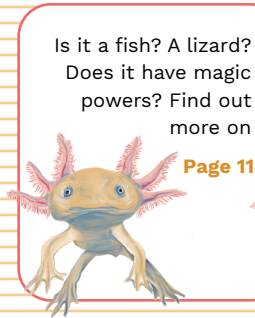
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Can mood rings **really** reveal how you're feeling? Or is it just basic chemistry?

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Is it a fish? A lizard? Does it have magic powers? Find out more on

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Are wolves an endangered species?

Find out more and how you can help

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Writing by MALKIA OKECH



MAGICAL HIEROGLYPHS

WATCH OUT FOR THAT GLYPH!

Imagine you are exploring a tomb. You scale down into the deep and dark corridors, feet gliding through the sand to make sure you don't find any hidden traps. You finally find the chamber of an ancient pharaoh, his sarcophagus glimmering with gold. Taking out your torch, you begin to look at the walls in order to learn more about this pharaoh. You come across a particular hieroglyph. It's moving! It's a snake! It wiggles about, trying to escape the wall. You don't know what to do! As the snake seems to try to squirm off the wall, it fails, falling into pieces. Upon further examination, you discover that whoever carved this glyph seems to have carved a stick through its body. Looking around the room, almost all of these snakes and other deadly creatures also are being warded off by weapons. Phew! The ancient Egyptians had your back!

HIEROGLYPHS ARE MAGICAL!

Ancient Egyptians practiced all sorts of magic. Egyptologists have been able to find, record, and translate many of their spells and sacred objects. The word for magic is heka, and it was practiced through writing, spoken word, and performance. Egyptians used magic for protection.

One way which Egyptians performed protective magic was to symbolically injure objects. Hieroglyphs are a perfect example of this! The ancient Egyptians believed that writing was magical, and hieroglyphs had the ability to come alive. This was especially

true for sacred texts in tombs. Therefore, they needed to take measures against hieroglyphs considered dangerous or scary, like snakes or crocodiles. This is where the ancient Egyptian word *peher* comes in. This word relates to magic that surrounds or encloses something for protection.

The first example of this protective kind of magic is from the Old Kingdom (approx. 2600 - 2100), in the pyramid of King Unas. One method of vandalizing a dangerous hieroglyph is to draw a line of sand through the middle of it. That way each half of the dangerous creature could not come back together. Let's take a look at an example of this, explained in an ancient Egyptian story called *Setna and the Mummies*:

He went to where the eternal snake was. He fought with it... It returned to life. He did the same thing again. He fought with it again for a second time... It return to life again. He fought with it for a third time... He placed sand between one piece and the other. It did not resume its form ever again.

Hieroglyphs are such an interesting form of writing, because they primarily use pictures and items from daily life to represent sounds, letters, and words. You don't need to know how to read hieroglyphs to notice the meanings of some words, because some signs provide clues! Therefore, a glyph of a dangerous creature being vandalized by a writer is a powerful tool. And it makes sense, because you would want to protect yourself from a snake or crocodile in real life too!



Design by AVA CRUZ



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Graphics by Freepik

Witchcraft

DEVIL'S MAGIC

It's a chilly night and you're walking down the sidewalk with your friends. Suddenly, you hear a loud cackling noise, like high-pitched and squeaky laughter. You look up to the black sky, and amongst the stars, you see three silhouettes. They've got pointy black hats... Their faces are green and their noses stretch and curve out like hooks... They ride on brooms, zooming past the full moon... Witches.

You've probably seen these kinds of scary depictions in movies or in real-life Halloween costumes. Hollywood has popularized these fearful images, especially around the end of October. However, these potion-making, broomstick-riding, revolting characters stemmed from a real phenomenon of human witches taking over villages. Some 300 years ago, pointy hats and green skin aren't what people imagined when they thought of witches. Instead, it was normal people, mostly older women, who were supposedly making deals with the devil.

The year was 1692. Some 15 miles east of Boston, in a colonial village called Salem, a group of young girls gathered around a West Indian slave woman to hear her riveting stories. In the dark of night, they were thrown into great fits of hysteria and believed they were being possessed by the devil.

This wave of madness spread quickly through the small town and found its way to the ears of the local officials. The young girls were questioned about their behaviors, and they blamed their torments on the supposed witchcraft of various women in the community.

A special court was convened to hear the strange cases of witch activities in the village; the first to be investigated was Bridget Bishop. She was hanged at Salem Gallow's Hill along with 150 other accused individuals in the following few months. The frenzy for false, but intensely believed, accusations became known as the witch hunt.

The hunt became popular for two reasons. First, a belief in witchcraft was not shocking in the 17th century; the idea of the devil inhabiting witches for the purpose of haunting others in return for loyalty had gained traction in Europe 300 years prior. Second, the village was undergoing a massive and rapid change from a Puritan community to a commercial town. This angered some of the traditionalist inhabitants, who were the primary accusers of the "witches": people who just so happened to be on the side of modernity.

A few years after the hysteria began, the colony of Massachusetts sought to restore honor for those condemned during the hunts. However, the infamous legacy of the Salem Witch Trials continues to live on; so much so that an eerie museum has been erected to recount the chilling tales of the women bearing the devil's magic.

Writing by ANIA ALBERSKI



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Dragonlore

Writing by CAROLINE LENG

In popular culture, dragons are always portrayed as magical and mythical beings. They are represented in many different ways, whether with flames and fear, or with humor and heart. These mythical beasts can be seen in novels such as Harry Potter and The Hobbit, as well as in movies such as How to Train Your Dragon and Mulan.

The history of dragons is represented in many different ways too, with myths from Sumeria to Europe. The etymology, or history, of the name "dragon" is rumored to have come from the ancient Greek word "draconta," which means "to watch."¹ Dragons got this name from their mythical tendency to hoard treasure and guard their valuables. In the Bible, dragons are painted as threatening and ferocious. They serve as a physical representation of the fire and brimstone of the underworld; it is also likely that medieval Christians believed that dragons were real.¹ On the other hand, the ancient Chinese used the myth of dragons to rationalize the existence of massive fossil beds in the country. These dinosaur fossils were thought to be dragon bones, and used as divine medicine.² In more recent history, many animals still seen today were thought to be dragons at first. Explorers and sailors returning from Indonesia reported dragon encounters, which turned out to actually be huge lizards.² European dragon legends may have been inspired by Nile Crocodiles, swimming across the Mediterranean to Italy or Greece. Their scaly, foreign bodies seemed so unbelievable, that crocodiles were seen as myth and legend.³

As an overarching theory of dragonlore, some anthropologists, within their study of various aspects of humans within past and

present societies, argue that there is an evolutionary reason that dragons are so common in so many ancient societies. Anthropologist David E. Jones believes that human have an innate terror of predators, and these fears were transformed into the myth of the dragon.³

Magic has many different purposes and meanings, and the myth of the dragon does as well. Whether it is used to explain the presence of dinosaur fossils or serve as a representation of Satan, whether it symbolizes the human race's universal fear of predators or a benevolent god, the myth of dragons adapts to the expectations of the era.¹ These mythical creatures have captured our eternal interest and will remain larger than life.



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Saving a Species

Writing by JAKE NIBAUER

It's a cold Alaskan night. One by one, glowing eyes emerge along the horizon. Flashlights? Aliens? No, wolves.

These special nocturnal creatures, capable of hearing up to 6 miles away, once roamed North America with a population in the millions. Today, the wild wolf population in the US is as low as 4,000.¹ The wolves risk extinction.

Why the massive decrease in the wolf population over the years? Long ago, many believed that wolves were a danger to humans, so they were afraid to live among such vicious creatures. These negative views formed about 600 years ago in the Middle Ages when werewolves – human wolf hybrids – were believed to roam the earth.²

This superstition ultimately led to the demise of millions of wolves and the threat of their extinction. If wolves were to go extinct, the entire species would disappear! Like the dinosaurs, no wolf would ever roam the earth again.

Sounds crazy, doesn't it? Yet the threat is real. If nothing is done, 500 years from now, wolves could be only a distant memory of the past.

Turner Burns, a 13-year old student activist native to Philadelphia, first learned

about the startling decrease in the wolf populations when he visited the Wolf Conservation Center in New York.³

At the Wolf Conservation Center, Turner heard the magnificent howl of a wolf for the first time.

"I was awestruck by his strong stance and incredible presence," Turner said. Very quickly, he fell in love with these intelligent, misrepresented creatures.

"You can imagine the sadness I felt when I found out that they were endangered... I was so confused," said Turner. "Why would anyone want to get rid of such amazing animals?" Inspired by the beautiful creatures and outraged by the decline of a magnificent species, Turner, only 6 years old at the time, set out to do something about it.

With the help of his mom, Turner started Kids For Wolves.⁴ His mission: "To spread the word about wolves and the trouble that they are in to fellow nature-loving children." Soon enough, Turner's Kids for Wolves Facebook page gained traction. Today, Kids for Wolves has over 5,000 likes on facebook!

Turner's website, kidsforwolves.org, highlights the many projects he has created to raise awareness of these awesome,

endangered animals. The website proudly displays the slogan, "Anyone can Advocate." Turner explains, "Making a difference is really easy and often far simpler than people take it to be. If a 6-year old me could manage to start Kids For Wolves, you definitely can start an organization you believe in."

In 2017, Turner started sending postcards across the United States to people who wanted to help save the wolves. The postcards read, "Save the Endangered Species Act!" so that wolf conservationists could sign the postcard and send it to their state representatives. Only 12 years old at the time, Turner did not let his age get in the way of sharing his opinion.

One week after beginning his postcard project, Turner's message was heard. Senator Bob Casey of Pennsylvania contacted Turner, offering him a visit to his political office in Philadelphia.

The trip was wildly successful, as Senator Casey voted in favor of keeping the Endangered Species Act alive and running. This way, wolves and other threatened wildlife would receive protection and hopefully their population would see a revival.

"Every single person in the world is capable of making a difference, and you should always be ready to stand up for things you believe in... Getting started with advocacy is really easy, and it can also be a lot of fun too!" Turner said.

With many projects still in the works, Turner does not plan on stopping his groundbreaking advocacy work any time soon!

As a pack of hungry wolves howl in the dark Alaskan night, you can be sure that 13-year old Turner Burns is up to hear them call.

**Interested in helping
save the wolves?
Visit: kidsforwolves.org**

Design by AVA CRUZ



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Mood Rings!

SCIENCE YOU CAN WEAR

Writing by JEREMY WYMAN

Josh Reynolds and Maris Ambats created the first mood rings in 1975 when they bonded liquid crystals with quartz stones that were set into rings.

These rings instantly became popular in the 1970s, and they continue to be produced and sold around the world to this day.

Despite being called, “mood rings,” they are actually just thermometers that change color in response to the skin heating up or cooling down.

They use a special chemical called a thermochronic liquid crystal. Thermochronic means that the substance changes color in response to a change in temperature. Liquid crystals are an unusual state of matter that are able to flow like a liquid but maintain a relatively rigid internal structure like a crystal.

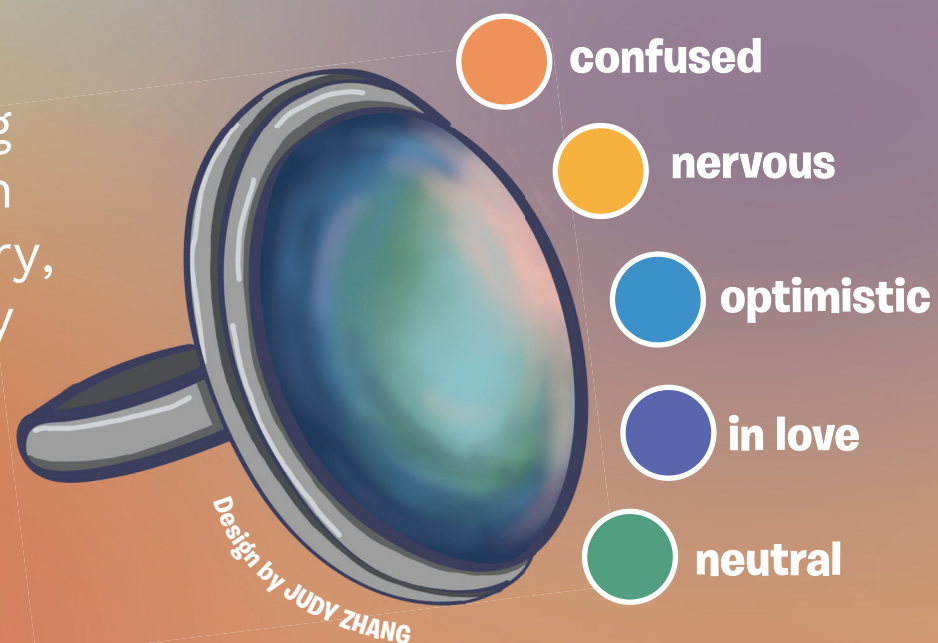
The more thermal energy that is applied to the thermochronic liquid crystal, the higher the frequency of the wavelength of light it reflects.

The colors that we see are waves that reflect or bounce off of the items around us. An apple is not red, it reflects the color red, which is why we interpret it to be red. Every color you can imagine has a unique wavelength. Red has the highest wavelength of all the colors we are able to see.

There are many different interpretations of the different colors of mood rings, but according to one of the most popular mood ring sellers: orange means confused, yellow means nervous, green means neutral, blue means optimistic, and indigo means in love.

To state it plainly, the hotter the mood ring gets, the more red and orange it gets.

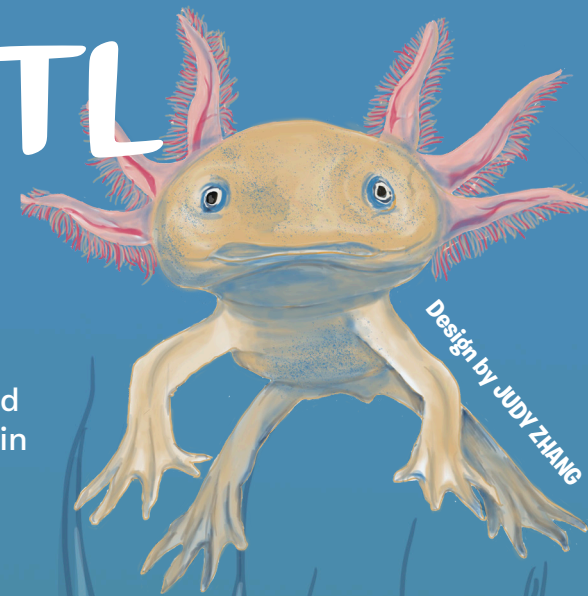
Your mood ring is not just a fun fashion accessory, it's a chemistry experiment too!



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THE AXOLOTL

Scientific Name: Ambystoma mexicanum
Colloquial Name in Mexico: Ajolote
Status: CRITICALLY ENDANGERED



One of the biggest questions in science today is how to regrow limbs and organs. While the answer still eludes scientists, it seems that a mysterious Pokemon-like creature lurking at the bottom of the Xochimilco River in Mexico City has already found the answer.

The axolotl (pronounced ack-suh-lot-l) is a salamander native to Mexico. It possesses the amazing ability to regrow internal organs and entire limbs with bones, muscles, and nerves included. What is even more impressive is that the axolotl can heal critically damaging wounds - like a crushed spinal cord.

Researchers hope that by learning from the axolotl, they will be able to develop technologies that would regrow human limbs without producing scar tissue. Though humans cannot regrow complex structures like limbs, they can re-generate specific organs. Did you know that most of the dust that you find around your

house is actually composed of dead skin cells? Your skin is constantly regenerating new cells as you shed old ones.

However, when it comes to complex structures, humans are incapable of regeneration because of the way they develop. Similar to the axolotl and other complex life forms, humans start their development as a single cell. When an egg is fertilized, the cell begins to divide rapidly into many cells. All of the cells begin as unspecialized, meaning that they could end up performing any function. As cell division continues, cells begin to specialize by taking up certain tasks. One cell might become a muscle cell, while another becomes a bone cell. All of these cells possess an entire copy of the person's DNA, which acts like a recipe book containing all the instructions cells need to perform tasks. However, when cells specialize, parts of the DNA close off, so each cell only knows how

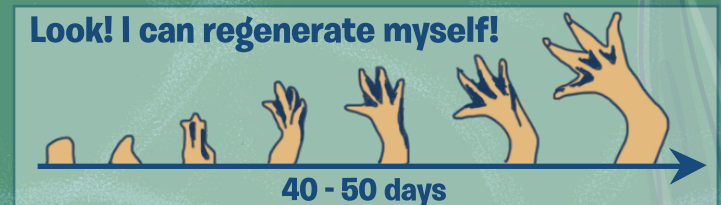
to perform its specific task. A liver cell only knows how to be a liver cell. For this reason, we are currently unable to regrow an entire limb or organ from just one human body cell.

So, what is so special about the axolotl that allows it to completely regenerate limbs and organs? Scientists have observed that at the site of an amputation, the cells transition into pluripotent stem cells, or cells that are unspecialized and are able to give rise to many different types of cells.

While we still don't completely understand how this occurs, scientists continue to gain new understanding about the mechanisms that are involved in regeneration, and are optimistic that they soon will be able to uncover the mystery behind the magic trick.

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Writing by SAMIRA MEHTA

HOW TO BE A TIME TRAVELER

Writing by DANA JONES

Design by DELIA CHEN

Space, Time, and Einstein

It is generally accepted that time moves in one direction, and one direction only: forward. With every passing second, the future becomes the present and the present becomes the past. Time seems simple enough to grasp, and yet for centuries, people have wondered, are we eternally trapped in the present, or is there a way to skip forwards into the future, or jump backwards into the past? This notion of traveling through time has fascinated mankind for centuries. However, it is only recently that time travel has advanced from the realm of fiction to that of reality. It all started when Albert Einstein published his theories of relativity, which describe how space and time can be viewed jointly as “spacetime.” These theories asserted that gravity is actually created by the presence of massive objects, such as stars and planets, that curve spacetime around them. Einstein’s theories of relativity revolutionized our understanding of the universe, and with it, our understanding of time. The possibilities were suddenly endless, and as scientists began to theorize about the various ways time travel could be accomplished, the world became something of a magical place.

Through the Wormhole

Sometimes, when an incredibly massive star dies, its core collapses in on itself, squeezing all of its mass into a smaller and smaller region until, eventually, a singularity point is reached, and the density becomes infinite. This creates a gravitational pull so strong that nothing can escape once it has come too close, not even light.³ That is, unless this dead star, known as a black hole, has a very exotic (not to mention very theoretical) counterpart known as a white hole—the opposite of a black hole, in which everything escapes it but nothing can enter it. A white hole, like a black hole, has a singularity point at its center, but instead of everything being crushed into that singularity point, everything is spewed out of that singularity point.¹

Time travel comes into play in the event that a black hole and white hole become connected at their singularity points, producing an entity known as a wormhole (imagine two funnels connected at the necks with their mouths facing away from each other). If a spacecraft could survive the descent into the black hole, it would then be expelled out the other side by the white hole, thus passing through a so-called fold in space-time, a shortcut between two distant points in the universe.⁵ And, according to theory, if one end of the wormhole is accelerated while the other is held constant, a time differential could be established. In other words, the wormhole would become not only a shortcut through space, but also a passage through time, allowing for both forward and backward time travel.²

Light Speed Travel

One of the most basic theories of time travel is centered around the speed of light. Currently, no man-made object has even approached the speed of light. However, theoretically, if a spacecraft could approach the speed of light, time would slow down for the people inside the spacecraft relative to Earth so that, when they return home, they would see that everyone around them has aged much more rapidly than they have. In other words, they would have traveled forwards in time. By contrast, if, theoretically, a spacecraft could exceed the speed of light, it is believed that it would travel backwards in time.² These theories are relatively simple, but, unfortunately, not very practical—even our fastest spacecrafts still only travel at a fraction of a percent of the speed of light. Moreover, the laws of physics prevent any object with mass from traveling faster than light.⁴ Luckily, there are still a few theories of time travel that don’t require spacecrafts to travel at such impossibly large speeds.

The Closed Timelike Curve

Another way to accomplish backward time travel would be to travel along a closed timelike curve, or CTC. To visualize a CTC, let’s imagine an ant is traveling from left to right along a piece of string that represents time, kind of like a timeline. Imagine that the left side of the string represents the past, the right side the future, and for every step the ant takes forwards, one second has passed—the ant has moved one second away from the past and into the future. Now, imagine that the string of time encounters a region in space that is curved by a very massive star. Because the string is in space, and space is curved, the string, too, will become curved. Now imagine that the star becomes even more massive, causing space to curve even more. The string continues to curve along with it. But now, let’s imagine that the star is instead a black hole, significantly more massive than before. It curves space so much that the string actually curls in on itself—if you curve a string enough, the two ends will meet, forming a circle—and now the past and the future, the two opposing ends of the string, have been brought together. An ant traveling along this warped string of time will travel from the future to the past, right back to where and when it started its journey, thus traveling backward in time. Of course, in reality, this string is actually fourth dimensional spacetime, but the implications are the same; many physicists believe that all that is needed to create a CTC is an object in space, like a black hole, massive enough to curve the fabric of spacetime back in on itself.²

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Writing by
SARAH ROOT

6 Magical Things

THAT YOU CAN FIND IN THE FOREST

Design by
AVA CRUZ

1

A **WILL O' THE WISP** is a fiery spirit found in a forest. In the myths, they are seen as dark and mysterious often leading travelers astray to be lost forever within the woods. The will o' the wisp fires actually do exist – and scientists have a non-magical explanation for why.³ Microorganisms in bogs and swamps can produce methane, a flammable gas often used for fuel. Other chemicals that they produce can spontaneously ignite the gas, causing the will o' the wisp flames. While not magical, this spectacle is still a natural marvel!

3

In Irish legends, a **BANSHEE** is a spirit that takes the form of a woman. Her keening scream is said to be an omen of death, and those who hear her are warned of the imminent loss.¹ If you go into a forest late at night, you too might hear these screams – but don't be alarmed! Many animals – such as rabbits, foxes, and barn owls – make a screeching sound that can mimic a banshee scream. So, if you hear a "banshee" scream, know that you have nothing to worry about!

6

If you were to come across a miniature, decorated home in the woods, you might believe it to be a **DWELLING FOR FAIRIES**. However, this magical place might actually be a bowerbird nest! Bowerbirds build cave-like nests on the ground and surround them with colorful objects in order to impress a mate.⁵ Their designs use different colored flowers, berries, shells, and even objects stolen from humans, such as bottle caps and money!

Folk tales talk often about mysterious rings of mushrooms that appear overnight. Their origins vary – some stories say they are caused by witches, other legends swear they are the result of fairies or elves dancing the night before.² But through each story, one thing is constant – you should never step foot inside this "**FAIRY RING**." The science behind fairy rings is a little less sinister. The mushrooms often grow underground, spreading outward in a circular pattern once they have eaten all of the food within an area. Sometimes, weather conditions or reproduction will cause the mushrooms to pop up, and ta da: a fairy ring appears!

2

4

The oddly-shaped trees from the **CROOKED FOREST** in Nowe Czarnowo, Poland, make the list because they look like they were produced by magic! These pine trees are known for their strange, North-pointing bend, which makes them look like an upside-down question mark. What makes them even more mysterious is that no one knows how these bends came to be.⁴ Did a huge snowstorm push the trees into their current shape? Or did humans purposefully bend the trees to make curved wood for boats and furniture? We may never know.

5

Have you ever taken a walk in the woods, and thought that you might have seen a face in a tree? You're not alone – many cultures across the globe have myths about **TREE SPIRITS** that can take human forms. Seeing faces where there are in fact none can be the result of an overactive imagination, or a psychological phenomenon known as pareidolia (par-i-DOH-lee-uh).⁶ It's not just trees either – rocks, clouds, even grilled cheese has caused people to see images of humans in objects. Sometimes the best magic comes from the illusions our own brains produce!

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Lord of the Rings

&

Harry Potter



ONE RING

The One Ring was forged by the Dark Lord Sauron in order to control Middle-Earth. Its powers vary with its bearer—the more powerful someone is, the more power he or she can gain from the One Ring. Nearly everyone exposed to the Ring is tempted to take it. Frodo wears the Ring on a chain around his neck as it slowly takes a toll on his well-being. The Ring can only be destroyed in the fires of Mount Doom where it was created.



OLD MAN WILLOW

This ancient, possibly evil willow tree residing in Old Forest has various magical powers, including the ability to move its trunk and roots, and to induce sleep to trap bypassers.



PHIAL OF GALADRIEL

These doors serve as the entrance to the dwarven mountain lair of Moria. They are difficult to find and enter, since they are only visible in moonlight. The inscription of the doors presents a riddle: "Speak friend and enter." After a few tries, Gandalf solves the riddle by speaking the Elvish word for "friend." The Doors are guarded by a lake containing the Watcher in the Water, a tentacled sea monster.



DOORS OF DURIN

SLYTHERIN'S LOCKET



This locket belonged to Salazar Slytherin and was eventually obtained by the Dark Lord Voldemort. After murdering a Muggle, he turns it into a Horcrux, a magical object that carries part of his life essence. In the *Deathly Hallows*, Harry, Ron, and Hermione take turns wearing the locket around their necks as it takes a toll on their well-beings. Since it is a Horcrux, the locket can only be destroyed in a few special ways.

DELUMINATOR



This object was gifted to Ron by Dumbledore. The Deluminator has the power to remove and grant light sources from the bearer's surroundings. It can also act as a guide. In the *Deathly Hallows*, after Ron angrily leaves Harry and Hermione, he is able to hear parts of their conversation through the Deluminator. "Happiness can be found even in the darkest of times, when one only remembers to turn on the light." – Dumbledore

WHOMPING WILLOW



This is a violent tree species capable of moving its branches to do severe damage. The most famous Whomping Willow is the one residing at Hogwarts.

ENTRANCE TO "THE CAVE"



This unnamed cave is where Voldemort hid Slytherin's Locket. It is very difficult to find, and preventative spells and measures were placed by Voldemort to ensure that others would have a hard time entering. The entrance is also guarded by a lake containing Inferi, which are zombie-like beings.

Written by HANNAH PAN

Design by DELIA CHEN

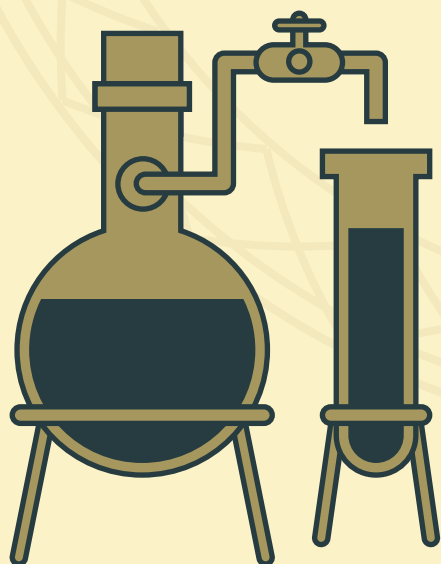
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ALCHEMY

Writing by MEGHANA IVER

ALCHEMY

Wouldn't it be really cool to turn any object into gold? If we could do that, we would all be rich! What if we could also create a medicine, called a panaceas, to cure any disease? These are exactly what scientists called alchemists attempted to do between the 16th and 18th century. The word alchemy contains the root "chemistry," which is of Egyptian origin.¹ Alchemy originated in Ancient Egypt, where the word "Khem" was used to refer to the fertility properties of the flood plains surrounding the Nile River. The ancient Egyptians' lifestyles were rooted in their mythological beliefs in the Gods, as well as the whole process of mummification and life after death. These beliefs are likely to have led to theories of immortality and regrowth, which are both core principles of ancient alchemy.²



Alchemy was also developed independently in other parts of the world such as China, India, and Europe. In China and India, monks and priests attempted to use materials from the environment such as water, minerals, and plants to discover an "elixir of life" which could purify and rejuvenate the body to prolong life. The origins of modern chemistry are evident in ancient Indian alchemy: after Indians invented steel and placed it into fire, they were able to see color! This technique, called the "flame test" is commonly used in chemistry to identify metals.²

The most modern version of alchemy originated in Europe near the latter half of the 18th century. The idea that gold was the most perfect metal and all others were less perfect led alchemists to pursue a substance called the "Philosopher's Stone" (Harry Potter, anyone?!), which could convert any substance into gold. Just like the Chinese and Indian versions of alchemy as mentioned above, Europeans also thought that this one substance could bring immortality.²

In the 19th and 20th centuries, modern chemistry rapidly developed and there were large advancements in the discovery of chemical compounds and reactions. Scientists started to look down upon alchemy as "child's play" and didn't believe it was a legitimate science. One historian of science in 1954 ridiculed alchemy and wrote

that "the theoretical contribution of alchemy to science is very small."³

MODERN ALCHEMY

It wasn't until the end of the 20th century and early parts of the 21st century that scientists began understanding and recognizing the true value which alchemy could contribute to modern science. By deciphering ancient texts written by alchemists, chemists and scientific historians recovered the past experiments and insights of these alchemists. One interesting experiment they discovered was a recipe for growing a "Philosophers' Tree" from a seed of gold. Alchemists mixed mercury and gold together in a flask and buried this flask in a heated sand bath. The next day, they would find the flask filled with a glittering "tree of gold." When combined, the mixture of metals had grown into a structure that resembled a coral or branches of a tree.⁴

As more of these ancient texts are deciphered, modern scientists have noted how alchemists actually performed legitimate experiments, obtaining and reporting genuine results. If you have taken a chemistry class before or are currently taking one, you probably learned about Boyle's Law, which is used to determine the relationship between pressures and volumes of gases. Boyle's Law is named after Robert Boyle, who is considered one of the earliest pioneers of modern chemistry

and the scientific method. However, historians have actually found that Robert Boyle "basically pillaged" the work of an earlier German alchemist named Daniel Sennert.⁴ Sir Isaac Newton, a great physicist, mathematician and innovator, contributed a tremendous deal to the field of optics, the scientific study of light. If you have ever seen a rainbow or have tried shining light through a prism into multiple colors, then you are replicating Newton's discovery! He showed that white light is composed of multiple colors. However, this idea — that all matter is composed of smaller particles — was

originally proposed during the times of ancient alchemy!

In a way, we are all modern alchemists. By exploring the world around us — its individual pieces, interactions, and processes — we are discovering new ways to think, discover, and apply what we are learning! Next time you perform a chemical reaction, mix two things together, or just simply observe the world, know that you are doing exactly what alchemists did thousands of years ago!

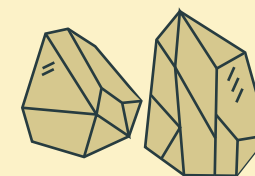
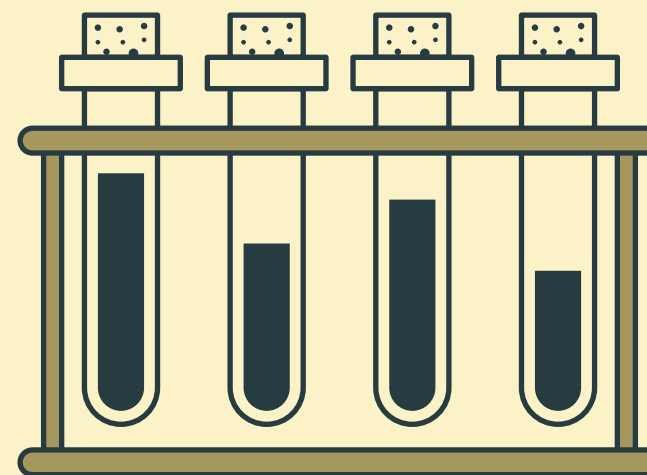
Let's Do Some Alchemy!

Let's make some dancing slime! This can easily be done with ingredients at home!

MATERIALS NEEDED:

- Cornstarch
- Water
- Food coloring
- Plastic sheet
- Music (from iPod, MP3 player, etc.)
- Portable Speaker

1. Add about 2 cups of cornstarch to 1 cup of water.
2. Add some food coloring - mix colors together if you want!
3. Place the plastic onto your speaker and pour your slime on top of the plastic
4. Start playing your music (REALLY LOUDLY) and let your slime move and groove to the music! If you so desire, you can add colors at this step to see how they mix together while the slime is dancing!



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The Northern Lights

Have you ever seen those green, flowing lights that illuminate the sky? Have you ever wondered why they appear, and why you might not be able to see them from your home? Have you ever heard of the Northern Lights? The Northern Lights, also known as Aurora Borealis, are the magical colors that float above us in the night sky.

MYTHOLOGY

You may be wondering - what did our ancestors think of the Northern Lights before they learned what the lights were? Well, it depends on who you ask. The name Aurora Borealis is derived from the Greek words sunrise, Aurora, and wind, Boréas. According to Greek mythology, Aurora was the sister of Helios and Selene, the sun and moon. Legend told that Aurora raced across the sky in her chariot, creating the green lights, to let her siblings know that a new day was about to begin. The Romans too believed in Aurora, the goddess of the dawn, and that the Northern Lights indicated a new day was beginning.¹

Years later in Europe, the French and the Italians believed that the lights were a bad omen. The Northern Lights are not usually visible from Southern Europe, but when they do appear, they are a dark red. Due to this frightening, blood-like color, the people of Europe thought that when the lights appeared, it was an indication that

there was going to be an outbreak of the plague or war. Although rare, the Northern Lights also held a place in Chinese mythology. The Chinese legends described the lights as being both good and evil dragons floating through the sky, battling one another with breaths of fire.²

WHAT EXACTLY ARE THE NORTHERN LIGHTS?

Now that we have learned some of the many exciting legends behind the Northern Lights, let us look at the science behind the lights! The Northern Lights are in fact a natural occurrence. The sun itself is extremely influential on the visibility of the lights, for the sun's electric currents create many magnetic fields. These magnetic fields distort and knot all of the magnetic fields together as the sun rotates on its axis. When the magnetic fields become distorted, sunspots are created, and the fields burst.³ The magic happens when debris from these bursts reach the Earth's atmosphere. Another key factor in the formation of the Aurora Borealis is the sun's extreme temperatures. The center of the sun reaches an impressive 27 million degrees Fahrenheit, causing it to bubble and boil on the surface. When the sun bubbles, particles of plasma escape from the sunspots of the sun and fly into space. These particles are known as solar wind, and they take around 40 hours to reach the Earth's skies. The particles travel around 93 million miles to Earth, and are drawn to the magnetism of the north and south poles. As soon as the solar wind particles permeate the Earth, they create the magical light display. The colors of the Northern Lights are predominantly green, blue, purple, yellow, and pink. These colors appear when the solar wind particles interact with the elements in the Earth's magnetic shield such as oxygen and nitrogen.⁴

Writing by
ANTONELLA
STURNIOLO

& Where to Find Them

WHERE AND WHEN TO TRAVEL TO SEE THE LIGHTS

After reading all of this exciting information, you are probably wondering - where can I find the Northern Lights? Well, don't worry - there are many locations around the world that offer visibility of these magical, flowing lights. The best places to travel are in the Arctic Circle. The northwestern parts of Canada, specifically the Yukon, Nunavut, and Northwest Territories, offer places to watch the Northern Lights.⁵ Fairbanks, Denali, and Anchorage in Alaska are some other fantastic locations in North America to see the lights. In Europe, you can travel to Svalbard in Norway, Kiruna in Sweden, and Luosto in Finland. The Northern Lights can also be seen on the southern tip of Iceland, in Reykjavik, and in Kulusuk, which is located in Greenland.⁶ The best time of year to visit these locations is during the winter, when there is less light pollution and a clearer, crisper air quality. Remember to bundle up when visiting to protect yourself from the cold. The lights are brighter and more active during the time of sunspot activity, and researchers have discovered that auroral activity peaks every 11 years. Be sure to follow NASA to hear about when there is new solar activity. You can even sign up for aurora alerts to let you know when the Northern Lights are about to put on a spectacular light show!⁷



Real photo of the Great Northern Lights!

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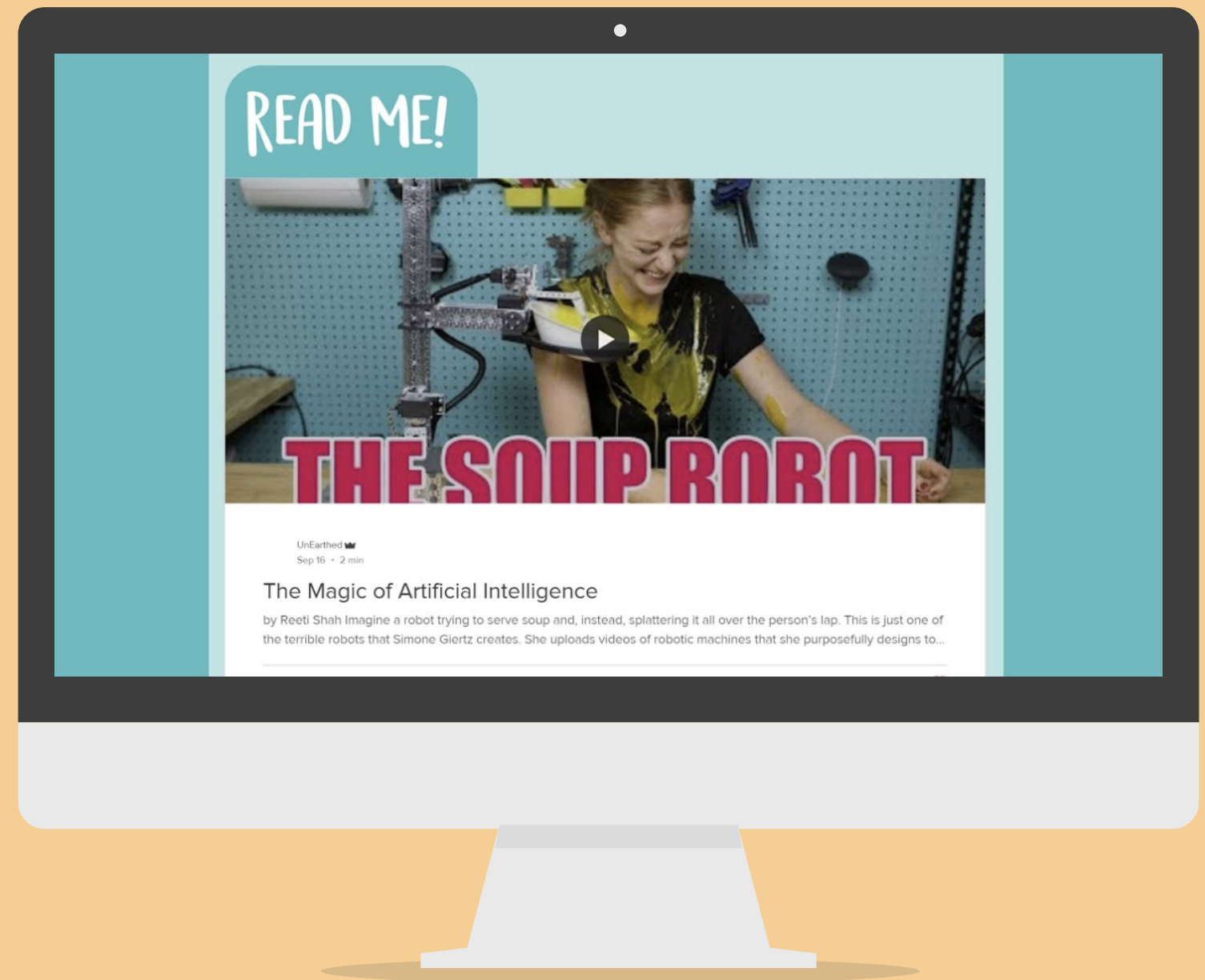
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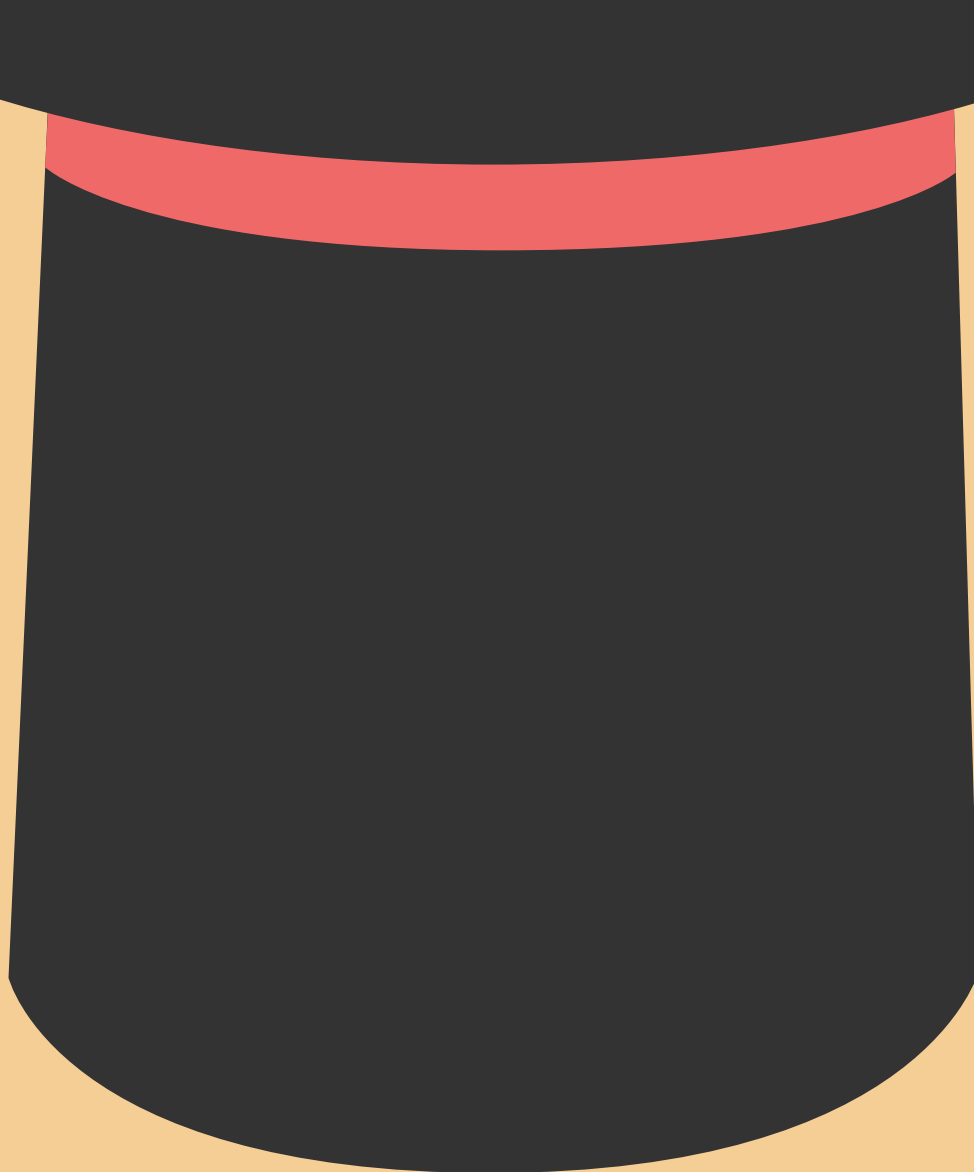


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