CATA PULTA

THIS ISSUE CONTAINS:

an interview with

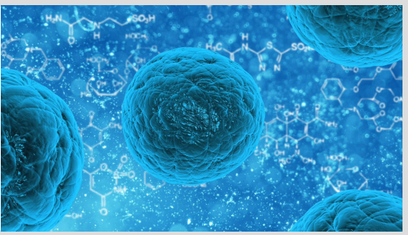
nobel prize physicist

sir anthony leggett

and student research

background essays

FALL 2021



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EDITORS' NOTE

DEAR READER,

THE TRANSITION BACK TO IN-PERSON SCHOOL HAS ALLOWED US TO RECONNECT WITH FRIENDS, ATTEND CLASS WITHOUT FELINE DISTRACTIONS, AND REALIZE THAT THE BLS FACULTY ARE MUCH TALLER (OR SHORTER) THAN EXPECTED FROM ZOOM. ALTHOUGH A "RETURN," A LOT IS DIFFERENT, EVEN FROM PRE-PANDEMIC TIMES.

IN THIS ISSUE, WE TRY TO REFLECT THAT MIX BETWEEN NOSTALGIA AND NOVELTY. IN ADDITION TO WRITING ABOUT TRIVIA TOPICS AND STEM FIELD UPDATES AS USUAL, WE ARE ALSO INCORPORATING A SECTION IN OUR MAGAZINE THAT SHOWCASES THE BRILLIANT WORK OF OUR SIXIE CLASSMATES. FINALLY, WE HOPE YOU ENJOY OUR INTERVIEW WITH PHYSICS NOBEL LAUREATE SIR ANTHONY LEGGETT, WHOSE CLASSICAL BACKGROUND (THAT'S RIGHT... LATIN AND GREEK) IN A SCIENCE CAREER SERVES AS THE PERFECT EXAMPLE OF THE BENEFITS OF A LIBERAL ARTS EDUCATION.

ASSUMING WE ARE NOT FROZEN FROM THE OPEN CLASSROOM WINDOWS BY THEN, WE WILL CATCH YOU ALL NEXT TIME!

WARM REGARDS,
ALEX CHOU AND SANJANA SINGH
EDITORS-IN-CHIEF

THANK YOU TO OUR FACULTY AND ADMINISTRATOR SUPPORT!

MR. GALEGO
MS. GARSIDE
MS. KWAN
MS. MOGUEL
& THE BLSA

SEASON ISSUE STAFF

WANT YOUR ARTICLE TO BE FEATURED IN THE NEXT CATAPULTA ISSUE?

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ENERGY ISLANDS IN THE NORTH SEA

Recently, National Grid entered talks with the UK and two other unnamed countries about constructing an energy island in the North Sea. Belgium is also planning an energy island in the North Sea with its own grid provider, Elia, and the Danish government has likewise committed to building two energy islands in the North and Baltic Seas. Evidently, energy islands are gaining popularity among European countries, but what are they, and what will they do?

Energy islands are hubs for offshore wind farms. They provide space for thermal storage facilities, high voltage direct current converters, and hydrogen generation. Most importantly, they can link to several different countries and provide electricity to places where it is needed most.

Energy islands have distinct advantages over current onshore wind farms. Dan Jørgensen, the Climate Minister of Denmark, states that "the energy islands allow for a cost-effective and gradual buildout where generated offshore wind power will be transmitted to markets around the North Sea. Energy islands can help transition the world into using renewable energy sources, providing both power and green hydrogen, and can mitigate the threat of climate change."

Of course, constructing these islands will be an engineering challenge. COWI, an international consulting group, has explored and studied four energy island concepts: caissons, sand, rocks, and a hybrid solution. Caissons are similar to seawalls and can protect the island from large waves, though they may be disruptive to the marine environment. A sand island would be the least disruptive to the environment and would act similar to a natural island, while a rock island would be comparable to caisson- and sand-based options. A hybrid solution could combine two or more of the above concepts. Each solution has its strengths and weaknesses and must be carefully deliberated upon before one is chosen.

As time passes, more information on these energy islands will be released. For now, construction challenges will need to be surmounted and public support gained. If the farms are successfully implemented, however, just a few could power the entire North Sea, setting an example for similar projects around the world, reducing carbon dioxide levels in the atmosphere and ultimately diminishing the impacts of global climate change.

HYCEAN PLANETS: A NEW HOME?

The quest to find another habitable planet has been ongoing for the past few decades. As the consequences of climate change become increasingly severe, this search is only becoming more urgent. Currently, scientists are investigating exoplanets, which are planets that orbit around a star other than our sun. To determine if an exoplanet is habitable, scientists first determine whether it exists in the "Goldilocks Zone" and orbits its star at a distance that prevents freezing or overheating; this condition would allow liquid water, a necessity for human life, to exist on its surface.

In August of 2021, astronomers at the Institute of Astronomy of the University of Cambridge reported a new class of potentially habitable exoplanets called "hycean worlds," derived from the large oceans and hydrogen-rich atmospheres found on these planets.

Comparable to massive ocean worlds, hycean planets are 1.6 to 2.6 times larger than Earth. While temperatures on these planets can reach up to nearly 200 degrees Celsius, the presence of liquid water is maintained due to surface pressure caused by the presence of hydrogen.

There are various types of hycean worlds. "Dark hycean planets" are tidally locked and contain two sides: one in daylight and the other in perpetual darkness, the latter side of which is habitable. Cold hycean planets, similar to Jupiter's moons Europa and Titan, are farther away from their star. Life on these hycean worlds would be dissimilar to organisms on Earth in that they would not produce oxygen. Therefore, scientists will need to look for different biosignatures, or evidence of life, such as dimethyl sulfide, methyl chloride, and other non-oxygen life-based compounds commonly found in the depths of the ocean.

As heat waves reach record highs and storms continue to demolish coastal cities on Earth, it is increasingly clear that a solution must be found. While only in the early steps of investigation, the new class of hycean planets poses new possibilities and should be further explored as a potential new home for humanity.

"To determine if an exoplanet is habitable, scientists first determine whether it exists in the "Goldilocks Zone" and orbits its star at a distance that prevents freezing or overheating; this condition would allow liquid water, a necessity for human life, to exist on its surface."

FIGURE I - GOLDILOCKS ZONE
Where should I live?

THE BROWN, THE BEIGE, THE WHITE: AN OVERVIEW OF FAT CELLS

There are three main macromolecules that are vital for the human body to function: lipids, proteins, and carbohydrates. Of these macromolecules, lipids literally give you the "best bang for your buck": ingesting a single gram of lipids provides nine calories, compared to proteins and carbohydrates, both of which only provide four calories per gram. This efficiency, however, also comes with drawbacks, and the possibly harmful impacts of fats on daily life are therefore critical to understand.

WHAT ARE FAT CELLS' CHARACTERISTICS?

Adipose cells, also called fat cells, are formed from ingested fats. These are created through progenitor cells, which are descendants of stem cells (cells that can develop into many different types of cells). After this process, fat cells become brown, beige, or white fat cells.

White fat cells, which vary in size, serve the most well-known purpose of fat in the body: as extra fat and energy storage. As fat quantity increases, so does their capacity, as the cell's need for fat storage likewise increases. On the other hand, brown cells are much healthier and differ from white cells because they contain many mitochondria that convert stored fats into energy. Mitochondria give off a brownish color, giving these fats their name. Alternatively, these cells can also be created through "browning," which occurs through exposure to cold temperatures or through exercise. White fat cells are capable of transformation through this process to become brown cells and, as such, use mitochondria to generate ATP cellular energy. The last type of fat cells, beige cells, are a hybrid between white and brown cells. With the ability to resemble white fat cells while resting or to act like brown fat cells during temperature drops, beige fat cells, along with the two other fat cell types, keep your body running smoothly.

TRANSFORMATIONS OF FAT CELLS

All fat cells have the capacity to change into different fat cells. Because most of our fat cells are already white, white fat cells more commonly transform into brown or beige cells, instead of vice versa. This process of transforming cells, in which a certain mature somatic cell becomes a different mature somatic cell and changes function, is called transdifferentiation. Transdifferentiation can happen either naturally, when certain genetic factors are present, or when environmental cues, such as temperature changes, take place. This process is the key to reducing obesity-related risks.

RISKS AND HARMS

The inherent risk of gaining an excessive amount of fat is that it increases visceral fats and fats in vital organs. Visceral fat, also called "active fat" because it affects hormone functions, is compressed near your abdominal area and your organs. An overabundance of this fat can lead to inflammation and can change how your body breaks down macromolecules. In addition, more visceral fat near your liver can increase the production of adverse cholesterol, and it has been linked to Type II diabetes, heart disease, certain cancers, and stroke.

Luckily, a healthy diet and exercise can significantly reduce this type of fat. The transformation of white fats into brown fats, which is crucial to fighting health-related risks, is made possible through the production and work of the hormone isirin during exercise. Slowly but surely, exercise, coupled with the production of brown cells, can dramatically improve physical health. In fact, data from the Memorial Sloan Kettering Cancer Center details 4.6 percent of the people with detectable brown fat had Type II diabetes, as compared to 9.5 percent of the people without. This trend was also seen with cholesterol, as 18.9 percent of people with brown fat had abnormal cholesterol, compared to the 22.2 percent of those without. Thus, the data suggests that brown fat helps protect obese people from the harmful effects of white fat, leading to better health outcomes.

CONCLUSION

All three types of fat cells—white, brown, and beige—are crucial for a healthy, functioning body. Using a variety of fat cell types, the body regulates energy levels and keeps itself healthy. While obesity from excessive visceral fat can increase health-related risks, they can be overcome through proper dieting and exercise. So, the next time you are sweating through a run or lifting weights, remember that the temporary pain allows your body to gain in the long run!

MICROSCOPIC ZOMBIES

When people think of brain-devouring organisms, zombies probably come to mind first. Fortunately for us, zombies—at least not life-sized ones—are not real! *Naegleria fowleri* is a brain-eating amoeba that, while not as large as your standard undead human, is still quite lethal.

This species was initially discovered in Australia during the 1960s by scientist Malcolm Fowler and is most often found in bodies of warm freshwater because of its thermophilic, or heat-loving, properties. According to the Centers for Disease Control and Prevention (CDC), *N. fowleri* thrives in temperatures of 115 degrees Fahrenheit, or 46 degrees Celsius, and typically feeds on smaller bacteria.

The life cycle of this brain-eating amoeba is split into three consecutive phases: the cyst, trophozoite, and flagellate. The cyst, also known as the dormant stage, is the birth structure of *N. fowleri*, and during this period, it does not have any harmful characteristics. Only in the trophozoite stage or the intermediate phase are these amoeba infectious and capable of causing sickness. The bacteria temporarily turns into a non-feeding flagellate when food sources are scarce, exhibiting behaviors similar to hibernating animals such as bears. Flagellates, however, can convert back into trophozoites when smaller prey are available and environmental conditions are favorable for their survival.

On rare occasions when an unsuspecting person is swimming in close contact with *N. fowleri*, the amoeba can travel up the nose during submersion in water and implant itself inside the brain of its host, where it begins feeding on the tissue. This results in a severe brain infection called primary amebic meningoencephalitis (PAM), which is characterized by symptoms of vomiting, fever, and possibly even death. Surprisingly, drinking water contaminated with *N. fowleri* does not cause PAM. When ingested, the bacteria does not travel to the brain but instead falls through the esophagus into the stomach, where it is destroyed by strong acids.

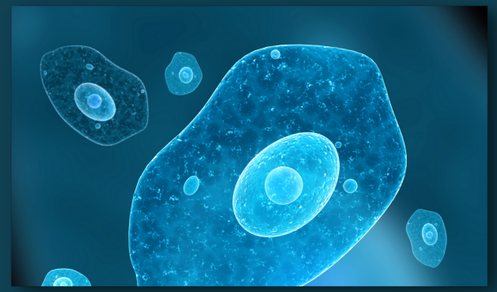
RADIOCARBON DATING AND VIKINGS IN AMERICA

"In 1492, Columbus sailed the ocean blue"—everyone learned this elementary school rhyme, which denotes the year European explorers reached the Americas. It marks a significant turning point in world history as one of the very first times the Eastern and Western Hemispheres made contact since the Bering Land Bridge was submerged. The Bering Land Bridge was a stretch of land that connected modern day Asia and North America during the most recent ice age. However, new discoveries suggest that this is not actually the case: while many theorized that Viking explorers from Greenland landed in North America prior to the arrival of Columbus, until relatively recently, little concrete evidence was found to support the idea.

Roughly 60 years ago, a married couple of archaeologists found the remains of wooden buildings and numerous artifacts on the coast of Newfoundland, Canada, in a site called the L'Anse aux Meadows. After further analysis, these findings seemed to be of Viking design. Many of the wooden remains had cuts that were likely made by metal implements, which the area's native inhabitants did not use at that time, but which were common among Viking settlements found in Greenland and other parts of Northern Europe. However, after they tested these materials with radiocarbon-dating, they found an extensive time range (between 900 and 1100 CE) of when the objects may have been created.

Radiocarbon-dating, developed in the 1950s, helps archaeologists determine the time period in which any organic material lived. This works by comparing the relative amounts of carbon isotopes present in the material, in particular carbon-12—a stable isotope—to carbon-14—which is unstable and decays radioactively over time. Carbon-14 is created when carbon-12 in the atmosphere is hit with cosmic rays from the sun, which allows scientists to also measure past environmental conditions. Specifically, it allows scientists to measure solar storms that increase the amount of cosmic rays that reach the Earth, known as "Miyake events." Recent studies of the L'Anse aux Meadows site have combined the radiocarbon-dating method with dendrochronology, the study of time based on tree rings, allowing scientists to calculate a much more precise date.

Although the chances of getting this infection are about as rare as winning the lottery, the fatality rate is 97 percent. Only four out of 148 people infected have survived encounters with *N. fowleri* in the United States. Since the symptoms of primary amebic meningoencephalitis are highly similar to those of meningitis (an infection of the tissues surrounding the brain), medical professionals often need to perform extensive tests that determine the presence of *N. fowleri*. Treatments for PAM are limited, but one effective drug, miltefosine, has been used in nearly every case of Naegleria.



Not to fear, though: *N. fowleri* can be avoided altogether by swimming in closely monitored water, such as a clean, regularly chlorinated pool or at a public beach. The next time you take a dive, make sure you are not swimming with hungry parasites!

According to Dr. Michael Dee, an associate professor of isotope chronology from the University of Groningen, there is a significant spike in levels of carbon-14 in one of the 28 tree rings from the outer layer, indicating a Miyake event. Astrophysicists have also proven the existence of a Miyake event that occurred within the Viking Age. Between these eras, researchers from the University of Groningen have determined the exact year of the creation of this Viking site: 1021 CE, precisely 1000 years ago. This discovery is an exciting revelation for historians and scientists alike. It sheds new light on the extent of the mobility of ancient cultures and what might be accomplished by combining unlikely pairs of scientific disciplines.

A Classics Background In The Physics World:

Physics Nobel Laureate Sir Anthony Leggett

In this feature, Catapulta Editor-in-Chief Alex Chou (I) spoke with Sir Anthony Leggett about how his studies of the Ancient Roman and Greek worlds guided him as a physicist. Leggett has revolutionized research in quantum physics and is recognized as a world leader in the study of low-temperature physics. In 2003, he won a Nobel Prize for his cutting-edge work on superfluidity.

In what way did the Classics shape your understanding of the world, and in what way did physics shape your understanding of the world? Did these two understandings corroborate or conflict?

In the context of the academic disciplines as a whole, Greek and Roman history occupies a rather unusual, indeed near-unique, position, in that if we exclude the new evidence which archaeology may from time to time turn up, it is essentially a closed subject, in the sense that the "raw data" is a fixed body of more or less agreed knowledge. Nevertheless, university departments devoted to these subjects still exist! I think what my pursuit of both the history and the literature of the Greco-Roman world taught me is, first, that human emotions and motivations don't change that much over 2000 years, and secondly, that however well-worked out a topic may seem to be, coming at it with a fresh eye may still produce fruitful and novel results.

How did physics change my understanding of the world? I think it taught me that it pays, before trying to answer questions already posed by others (whether in science, human relations, or whatever), to sit back a little and ask whether they are the right questions, and in particular, whether they can at least in principle be given quantitative answers.

I don't think these two types of "enlightenment" are mutually inconsistent, any more than I feel that strong religious beliefs (which I myself don't have, but which I respect) are inconsistent with a successful career in science.

Flip for more questions!

Many students see STEM and the humanities as two very disparate fields — what would you say to such students?

Well, yes, in general, if you pick a random STEM subject and a random subject from the humanities, they may well look very different. However, there are numerous points of contact, and one which I know particularly well is the contact between physics and philosophy. Ever since physics emerged as a separate discipline (which we can perhaps date roughly from the work of Newton) it has raised questions for philosophy, and conversely, philosophers have been able to challenge the unspoken and often unconscious assumptions which physicists raise in their work (I sometimes say that one of the main functions of the modern sub-discipline known as "philosophy of physics" is to keep the physicists honest!). An example of the type of specific problem which might be discussed at a joint philosophy-physics meeting is the status of counterfactual statements (example from the legal area: "Had the accused not pushed his victim down the stairs, she would still be alive today"). This is a question which has long puzzled professional philosophers, but modern physics has given a new twist to it by the apparent demonstration that at least at the atomic level, counterfactual statements cannot possess truth-values.

What about the more specific case of the classics? Actually, there are some surprising connections. A few years ago, the classics department here at UIUC organized a conference entitled "One book, the whole Universe: Plato's Timaeus today" and I was invited to give a talk on "Plato's Timaeus: some resonances with modern physics and cosmology". When I tentatively accepted the invitation, I was a bit doubtful that I would be able to make any connection other than a very superficial one. However, what turned out was that while Plato's "answers" on matters of interest in modern physics mostly bear little connection to our modern understanding, his questions are surprisingly enduring and indeed resonate strongly today. (My talk is included in the proceedings of the conference, a book of the same name published by Parmenides Press in 2009 or maybe 2010).

"Human emotions and motivations don't change that much over 2000 years."

How was a Classical background beneficial for your physics career? What were some ways that you applied the skills and knowledge from a Classical education while learning physics concepts or conducting physics research? Or, how did the Classics shape the mindset you used when problem-solving?

Well, I'm not sure that the languages or history were a direct help. But the philosophy was an enormous help. Two questions which philosophers ask all the time are "what do you mean?" and "how do you know?". Physicists ask these questions far too seldom, and I have found it enormously helpful to ask them rather persistently, even if it sometimes causes irritation among my professional colleagues.

Classics such as Latin and Greek serve as foundations for many cultures and languages nowadays. Similarly, physics is arguably the “fundamental science,” the basis of biology and chemistry. How do you see your accomplishments in physics with superfluidity and low-temperatures evolving over the next century and becoming the foundations for future scientific endeavors?

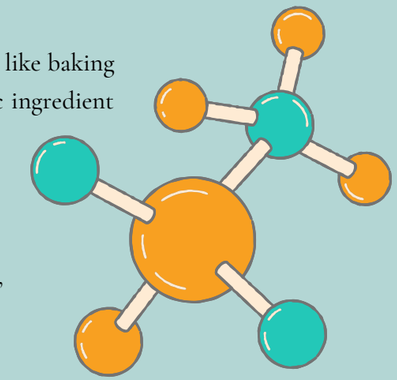
While I'm confident that the discipline of physics as a whole will retain the fundamental position it now holds among the "hard" sciences for at least the next century. I think it would be optimistic to hope that my specific research on quantum liquids will be particularly prominent in its future role. If it is, it may be through the realization that there are other kinds of systems (perhaps biological ones) in which a very large number of elements are constrained to behave "in sync", and that this can give rise to kinds of behavior quite different from that shown by the individual elements acting independently. (I suppose you could call this a version of the "emergence" idea, though I'm not particularly fond of that term as I think it mixes a number of disparate considerations including this one).

The Chemistry of Leavening Agents

My research topic is leavening agents. Leavening agents are chemical substances used to make dough rise. Understanding leavening agents can help prevent the problem of flat, tasteless baked goods: using the right amount of leavening agents gives food the perfect rise, while keeping its flavor and giving it a fun spongy consistency. In addition, it is unhealthy to ingest all of the icing, frosting, and other ingredients that are hard to digest, but leavening agents can rectify this problem. From spongy baked goods to high risen goods, the options are endless when you know how the different leavening agents perform!

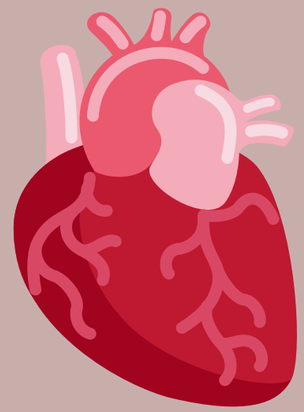
An important concept in chemistry is understanding how chemicals work in leavening agents. The best leaveners to use are baking soda, baking powder, and yeast. Leavening agents undergo chemical reactions when they come in contact with what they react to. Depending on the leavener, it might be moisture or heat. The chemical reaction releases carbon dioxide in the form of little air bubbles that rise the dough. Do not forget, though, that if you add too much of a leavener, it could create an overabundance of chemical reactions that releases too much air. Many of the air bubbles could pop, and the baked goods could end up flat.

Another important topic is how components in chemical reactions like baking soda and baking powder differ. While baking soda needs an acidic ingredient (like honey or chocolate) added to the mixture for it to be used as a leavening agent, baking powder does not since it innately reacts to moisture. To prevent baking powder from reacting too early, it usually contains starch that soaks up any extra moisture. Thus, it is essential to know that chemical reactions' products depend on the components added to them.



3D BIOPRINTING HEARTS

My research topic is about 3D printing hearts. Bioprinting is a type of 3D printing that prints using living cells and biomaterials rather than plastic. It can help people with organ deficiencies receive replacement organs as soon as possible. For example, if someone has heart disease or lung cancer, they can get a replacement heart or lungs in just a few months instead of waiting for donor organs. This is especially helpful because not many people are willing to donate their hearts or lungs. By using bioprinting, humans can find new ways to extend their lives. Bioprinting also has the capacity to bring back the dead by using deteriorating cells from the body to recover the brain.

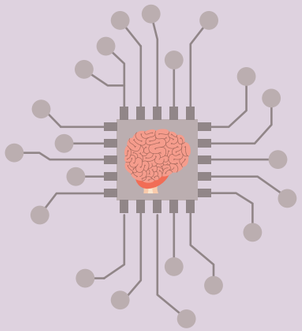


An important concept in this branch of science is that the heart is composed of just a few cells with one major function: to contract and beat. If the bioprinted heart is made from the patient's own fat cells, it will not be rejected or attacked by the patient's body. This means that if we can find a way to get an artificial heart's cells to work together to contract and beat, we can have an actual way to do heart transplants without using donor hearts.

Some people are already using bioprinted organs, like bioprinted livers. These have the potential to save the lives of infants with birth deficiencies, as their diseased organs can be replaced with fully-functional artificial ones. Researchers have already created a small heart the size of a rabbit's; if we can successfully find a way to print other organs, such as a full-sized human heart, we can cure fatal diseases.

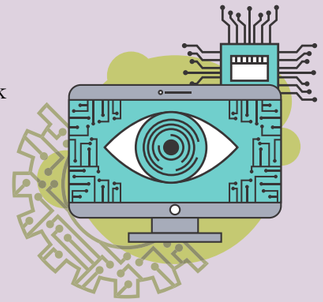
Psychological Principles in Animal Learning

My research topic for the science project is dog psychology, which is a branch of animal and behavioral psychology. Animal psychology studies how animals interact with each other, their environment, and humans, while behavioral psychology studies observable behavior, or measurable animal and human actions. Studying dog psychology is important because many experiments can be done on dogs to promote their well-being. For example, an experiment in 2017 played classical music for dogs in a shelter. The results concluded that the dogs responded well to the music. By studying how dogs process information, react to stimuli, and perceive the world, we can draw conclusions about their behavior. Additionally, dogs are typically very loyal to their owners because of genetic traits and the process of domestication. By understanding how they learn and perceive their environment, we will be able to help dogs have better relationships with us and will be better equipped to treat them better.



An important concept in this branch of science is animal behavior. Animals act in certain ways because of reflexes—which are automatic responses—and, more specifically, conditioned reflexes, which are somewhat controlled. Stimuli (objector events that provoke a certain reaction) elicit animal responses (conditioned reflexes). Animals can learn if they are rewarded for a certain behavior in response to the stimuli. Because of their natural instincts, what they have learned, and what they have experienced, animals can have different responses to stimuli. We can learn a lot from this when deciphering behavior.

Animal behavior can also be linked to human behavior. An animal's response to stimuli might give clues about how a human should respond to it. Dogs think like humans in many ways, displayed through their reactions to stimuli. No matter the breed or the type of experiment, it has consistently been found that dogs are more intelligent than we believe, and there is always something to be learned about their loyalty and intellectual capacities.



Owl Adaptations to Tree Evolutions

My research topic is the evolution of owls and trees, which relates to biology, and, more specifically, ecology and evolution. Ecology is the branch of science that studies the relationships between organisms, while evolution is the change in the characteristics of a species over multiple generations. Evolution is extremely important and can affect the organisms on our planet in both positive and negative ways. Climate change is another issue that is creating a huge impact on the environment and its species. Even minor temperature increases can negatively impact certain organisms' abilities to survive, as the loss of stable climate conditions may lead to their endangerment and even extinction.

Owls are connected ecologically to their habitats: trees. Owls need the temperate environment of trees for vital life tasks like camouflaging and raising their young. Thus, owls will evolve as trees evolve, and vice versa. The same idea applies for many other species, and a large cause of evolution is currently climate change.

If a species is unable to adapt to their surroundings, extinction may follow.

Since many organisms have specific heat and pH requirements to survive, populations of such organisms must adapt to their surrounding environmental and weather changes over time through evolution by natural selection. However, successful evolution by natural selection is a process that can take generations, which means that many organisms are in danger due to climate change, a rapidly-occurring phenomenon. If a species is unable to adapt to their surroundings, extinction may follow.

HARNESSING HYDRODYNAMIC POWER

My research topic is about harnessing the power of hydrodynamics in underwater movements. The branch of science that my topic is related to is physics. Physics studies the properties of matter, including its fundamental constituents and their motion through space and time, as well as related entities like energy and force. Hydrodynamics is the study of liquid in motion.

This topic is significant because utilizing the principles of hydrodynamics can reduce the time and energy spent to reach a destination. Hydrodynamics can influence matters from your fastest race time in a pool to the money spent on the fuel for a military submarine. Mastering hydrodynamics enables the efficient design of ships, airplanes, pipelines, and other necessities. We need ships to transport goods, planes for travel and defense purposes, and channels for clean water. We can further improve these things by observing aquatic animals. The humpback whale, for example, uses the tubercles on its fins to stall in the air and quickly turn at a sharp angle; this motion can be modeled in military or small passenger planes.

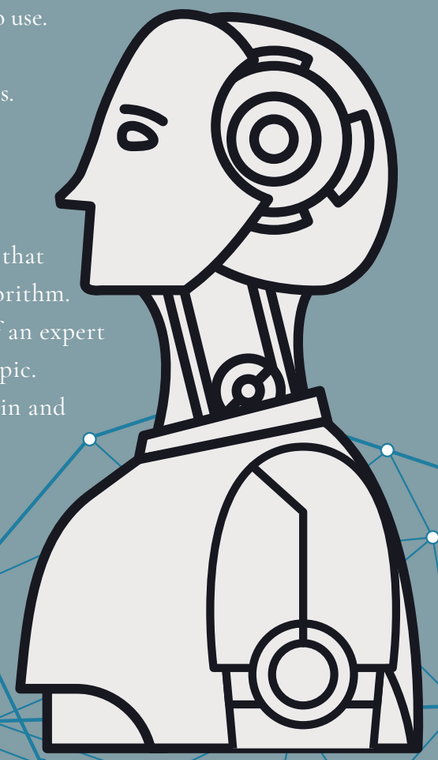
An essential concept in hydrodynamics is that turbulent flow can be better at increasing speed than laminar flow at times. Although laminar flow decreases skin friction (the resistant force that is put onto a moving object in a body of liquid), it also increases pressure drag (the aftermath of increased pressure in the front of a moving object and the decrease of pressure on the rear of a moving object). The opposite is the case for turbulent flow. This can allow objects to move faster. The Scottish, who invented golf, discovered this when they tried to play golf with a smooth golf ball. Other factors that determine the speed of motion include density, specific weight, specific volume, gravity, viscosity, and surface tension.

Exploring AI and its Applications

My research topic is artificial intelligence (AI). Artificial intelligence is related to many branches of science, including robotics and psychology. Robotics is the study of mechanical engineering and is used to build robotic systems for AI to inhabit. Psychology studies the human brain, which is essential to understand for replication in AI algorithms. Researching AI is important because AI is our future and can bring changes that improve our lives. For example, AI can detect and prevent diseases, from recognizing cancer to identifying individuals at risk of suicide. AI can also improve daily life: robotic dogs for allergic dog-lovers, robotic chefs that lower costs of food, and food delivery robots that transport food faster. Thus, it is important to research and develop AI.

There are some basic terms that one needs to know to fully understand AI. Algorithms are rules that an AI system follows to fulfill its purpose. Researchers use knowledge from other branches of science and implant information in AI to supply knowledge for the system to use. Sometimes these rules or information can be affected by human bias and can diminish the quality of life for people, especially those in marginalized groups. Sometimes, the makers of these AI may not even know about the biases in their products, so it is important to study AI to detect these biases.

Other terms include parallel and expert systems. An expert system is AI that has certain “expert” information on a topic embedded in its system’s algorithm. The AI uses this data to solve problems within the topic. A limitation of an expert system is that it is unable to find or do anything outside of the expert topic. On the other hand, parallel systems are built to “parallel” the human brain and are able to replicate human intelligence with a more flexible skill set.



PUZZLE FOUR FUN

Imagine doing math problems with each whole number represented only by fours!

Whoosh! Whaash! Zap!

You are teleported to the Four universe, where every digit has to be represented by 4. Solve the four problems below and get them right to be eligible for a gift card!

The Rules:

1. Each number has to use only 4s to solve it.
   - e.g. 4 * 4 - 4 * 4 = 0
2. Each problem requires you only to use four 4s.
   - e.g. (4 - 4 ÷ 4) * 4 = 12
3. You may use any operation except for logs.
   - e.g. -, +, x, ÷, !, $\sqrt{\ }$, decimals (0.4), concatenation (44), exponents (4^4)

Good luck!

Problems:

1. Find a sequence of fours that will get out 24.
2. Find a sequence of fours that will get out 3.
3. Find a sequence of fours that will get out 20.
4. Find a sequence of fours that will get out 19.

Submit your answer to catapultasciencebls@gmail.com **for the chance to win a $25 gift card!**