

## From the Editor's Desk

Dear Reader,

In this second issue of the term, we bring to you a lot of things.

One of them being, the famous Milgram's "Memory and Learning Experiment", which never fails to reveal the truth about human behaviour.

Another being an insight into animal behaviour, an area that is still being intensively explored . Why do animals do what they do? Some of your questions will be answered here (We hope!).

Many myths, for instance, the importance and necessity of drinking eight glasses of water in a day, have been scientifically (so to speak) busted! In today's era, where everything is being served to us via Google , we never question the relevance or the validity of statements and "facts".

The objective of science is not about blindly believing theories and observations. It is about questioning, analyzing, understanding and authenticating. It is definitely not about rote learning; something which all of us do. So, through this edition, we hope to unlock all treasure boxes within you, which, like Pandora's boxes, will finally open to let loose an unquenchable curiosity within...

Happy Reading!



Editor-in-chief  
Manishka Banerjee

# Nostalgia : Frog Diaries

As a young student of Science, being in the Biology lab was the most exciting time of School. The endless rows of bottles with specimen soaking in formaldehyde and shades of amber and scarlet were great backdrops for some nerdy romances. The unmistakable pungency of the chemicals must haunt a few of us, I am sure, just like an old tune does. Until class X, that was the Bio lab for me. And then, the frog dissection happened.

None of us was prepared for what lay ahead, essentially because none of us knew we were going to cut open a living, breathing frog and peep into its insides. In the 4<sup>th</sup> period, we all happily trotted to the Bio lab, when an unfamiliar stench stopped us all in our happy trot as we came upon buckets of semi-conscious, slimy, green 'Rana Tigrinas'. "We are going to dissect frogs today," our lab assistant announced. Nervously, we watched the assistant plop half-dead frogs on our boards. We were instructed to pin it on its back so that it looked like this:



Naturally, none of us moved a finger. The lab assistant had to spend the next 15 minutes trying to pin each frog on the board while a few girls got sick. Our Bio teacher entered the lab with a big 'the-joke's-on-you-losers' grin and said we have exactly 15 minutes to cut open the unconscious frog and investigate each and every organ. We all opened our dissection boxes and pulled out the tiny scalpel. In a little while, we would all have crossed the threshold into becoming cold-blooded murderers with the blood of innocent frogs on our hands. A few girls and boys balked out and had to suffer a minus 5 in their practical exam. I, for some strange reason, stood my ground. Could I be a cold-blooded, mean-spirited sadist? Was I going to grow up to be a serial killer who haunts the back alleys of towns and preys on innocent people just for the kicks? Could that explain why butcher shops didn't bother me or squishing a cockroach with my 'chappal' was almost a fun activity? With shaking hands, I brought the scalpel near the spread-eagled frog. I could see its yellow underbelly heave slowly. Was it aware of what fate lay ahead? Would it not feel any pain since it is so heavily sedated? Will blood spill all over from that tiny body? Was it a boy or girl? I was soon going to find out.

I steadied myself and touched the soft belly with the scalpel and tried to make a cut. At the very moment, the frog opened its eyes and stared right back at me! Before I could recoil from the shock the frog started fidgeting and pried open the pins on its forelimbs! That was one strong frog! I screamed and the lab assistant came running, fearing the worst. The frog had by then got its right hind leg free and was moments away from freedom when the assistant grabbed it and threw it in the bucket where traces of chloroform remained and the poor frog became unconscious again. Someone else too had fainted by then. Me.

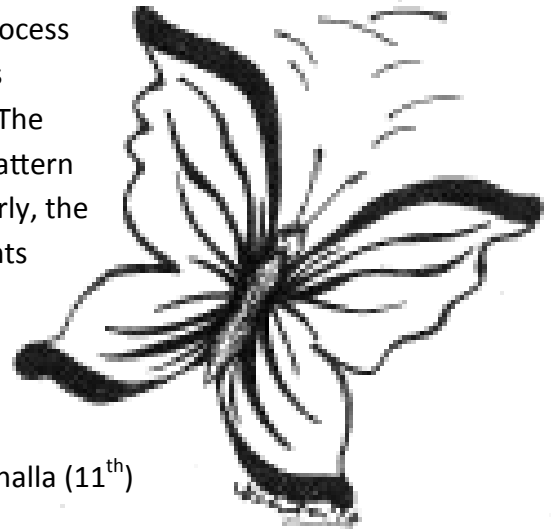
**PS: Thankfully, the practice of experimenting on live animals in schools and universities was stopped in 2010.**

# THE THEORY OF CHAOS

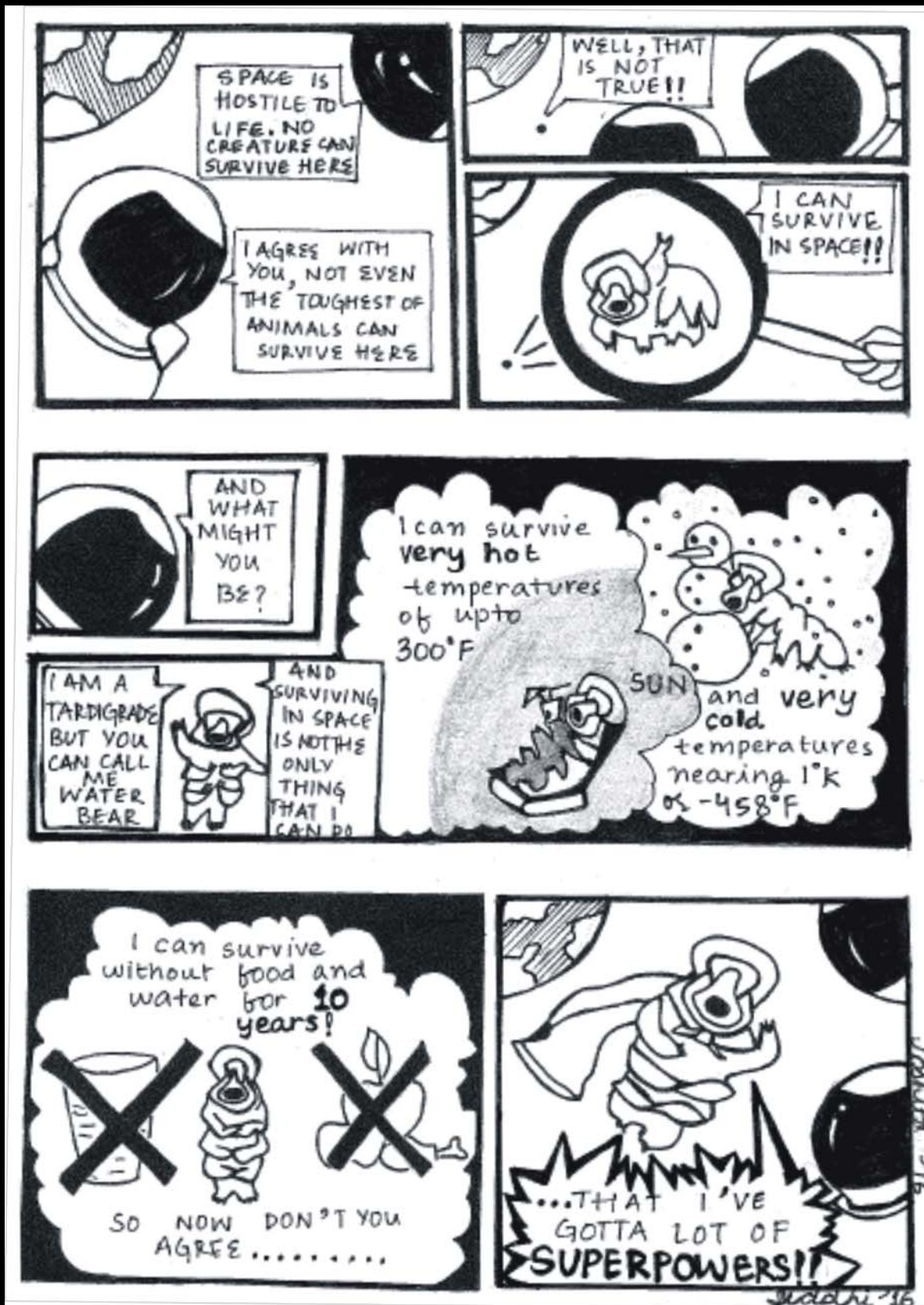
Humans are curious to know the future. We seek to predict various areas such as weather, prices in the share markets, interest rates and so on. Just so that we can control our lives, we hunt for elaborate and costly equipment to serve this purpose. However, has our ability to predict the weather and the aforementioned phenomena really been reliable? Do the natural phenomena follow a predictable pattern? Do they repeat their outcomes in a cyclic fashion? Science for years has relied on patterns to formulate theories. Nonetheless, the Theory of Chaos is shaking up the scientific world.

Not many are aware of the existence of the Fourth dimension. Unlike the first, second and third dimensions, the fourth dimension does not consist of lines, planes and solids, the fourth dimension is the world in which we exist. It is in the fourth dimension that even negligible changes lead to diverging outcomes. The Theory of Chaos also known as the Butterfly Effect, uses the analogy that the fluttering wings of a butterfly in one part of the world could result in the formation of small air turbulence and amplify into a hurricane in another part of the world.

No one will even imagine that something like The Theory of Chaos can only be explained by complex numbers. Complex numbers have a property to move closer to infinity after every duplication. It is this property which explains why humans are unable to accurately predict the weather or a natural calamity. Keeping this in mind, Manderlot gave a formula " $z \rightarrow z^2 + c$ ", where one always starts the iteration process with  $z$  equals to 0 and  $c$  equals to any complex number. This formula gives rise to an endless series of random numbers. The series of numbers formed are repeated but do not form a pattern which makes it impossible to estimate the next term. Similarly, the dynamic nature of the fourth dimension has a series of events like natural calamities, weather and so forth which do not follow any configuration, thus making predictions a vague idea.



# Tardigrades!



## Would you do it?

*"Please continue. The experiment requires that you continue. It is absolutely essential that you continue. You have no other choice, you must go on."*

This was the command given to the people when they refused to continue to give high voltage shocks to others any longer. Are you wondering why they did it? Well, they were tricked into Milgram's "Memory and Learning Experiment". The experiment was started in July, 1961, three months after the start of the trial of German Nazi criminal, Adolf Eichmann. The aim of these Yale undergraduates was to answer the million dollar question of their period- 'Could it be that Eichmann and his million accomplices in the Holocaust were just following orders? Could we even call them accomplices?' This experiment measured the willingness of men, from a diverse range of occupations, to obey the orders of an authority figure who instructed them to perform acts conflicting with their consciences.

In each trial of the experiment, three people filled three distinct roles; the 'Experimenter' (an authoritative figure played by a confederate), the 'Teacher' (a role intended to obey the orders of the Experimenter) and the 'Learner' (the recipient of electric shocks from the Teacher). A few hundred paid volunteers were ushered into specially constructed booths, with an intercom and a 'Shock Generator, Type ZL'. Prior to the actual test, the 'Teacher' was given a sample shock to be able to feel what the 'Learner' would feel each time the 'Teacher' pressed the button. They had been told that the 'Teacher' had to make the 'Learner' learn pairs of words. The 'Teacher' had to read out the pair of words to the 'Learner'. Then, he had to read out the first word and ask the 'Learner' for its pair. If the Learner gave the wrong answer, he had to be given an electrical shock, which increased by 15 volts each time!

Believe it or not, but in spite of going under tremendous stress and tension, more than 60% of the volunteers were prepared to administer a charge of 450 volts to the 'Learner', once they were assured that they would not be blamed for the consequences! The 'Teachers' were later told, that the 'Learners' were actually associates who were acting like they were volunteers, and that the 'Shock Generator' did not really give shocks to the 'Learners'. The painful screams and desperate banging on the walls had been a pretense. The experiment caused outrage amongst people. They blamed Milgram for tricking hundreds of people into going through the trauma of causing someone so much pain and suffering.

This experiment proved that majority of people would actually perform heinous crimes if only someone assured them that they would not be held responsible; that they would not be blamed; that they were just following orders. In this world where everyone wants to be a hero, most of us are just like a herd of sheep, waiting for their shepherd.

- Sakshi Manglik (11<sup>th</sup>)

## A Trip to the Wildlife Institute !

We all know evolution as a major process by which organisms may change their various traits or characteristics over a long period of time. It occurs at the population level and is extremely difficult to predict. Many competing theories regarding the evolution of species have been put forward by Charles Darwin, Lamarck and many other scientists to whom we owe a lot; if it was not for them our sense of ecology would be very different today.

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Just like Darwin found rocks containing fossils of sea shells in mountains and dug up fossils of extinct mammals like the ground sloth, the EVS girls led by Mrs. Reema Pant visited the Wildlife Institute to see how animals have evolved from the beginning of time. It was an enriching experience, for we learned to measure animal fossils, saw how various bones move together in union and made distinctions based on their characteristics. We also measured the teeth, orbit size and skull size of various species. Seeing the jawbone we could tell how old the animal was and whether it was a carnivore or a herbivore. It was interesting to recognize the various parts of an animal like the antorbital fenestra, subnasal foramen and external naris. Together we observed and felt what lay under a mammal's flesh.

Altogether it was very stimulating and this was followed by a nature walk through a jungle that was enough to startle our senses. We interacted with nature in a friendly manner and tried to contain our excitement while admiring the wood spiders and other species created by nature. Finally, we had to call it a day but it was one that really packed our brains with valuable information and made us feel like budding environmentalists in search of answers.

-Sairaa Bains (9<sup>th</sup>)

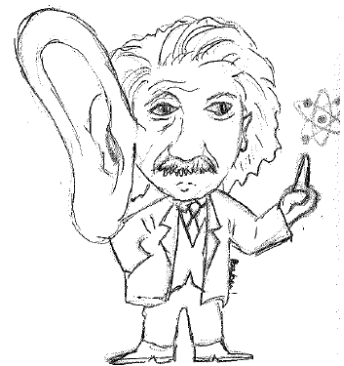
Bio-physics

## Role of the Ear Ossicles

Imagine a world in which the roaring of a jet plane would sound no different from the rustling of leaves. This is what the world would be like if we didn't have the three tiniest bones of our body – the ear ossicles. The middle ear ossicles are arranged and interact with each other as a lever system. By applying a large force over a small distance at one end one can produce a larger force over a smaller distance at the other end.

Why is such a large force even required? This is because the cochlea in the inner ear conducts sound through a fluid, instead of air. This fluid has a much higher inertia than air (that is to say, it is harder to move). Imagine pushing water as opposed to pushing air. The small force exerted by sound waves at the eardrum is not strong enough to move this fluid. The sound needs to be amplified. That's when the ear ossicles - 'malleus', 'incus' and 'stapes' come into play.

The malleus is much longer and the piston-like action of the stapes generates amplified vibrations in the fluid filled inner ear that are used to overcome its inertia and cause the fluid to move. Without the ear ossicles, only about 0.1% of the sound would make it into the inner ear. Not all animals have the same middle bone configuration as humans. For example: Reptiles, amphibians and birds have a middle ear that contains just one bone called the columella. This allows them to hear up to 1000Hz, that means they lose their ability to hear clearly at higher frequencies quickly, whereas we humans can hear sounds of much higher frequencies (about 20,000Hz), owing to our efficient ear ossicles.



- Aastha Saraaf (11<sup>th</sup>)

## Be(e)loved!

"I'll die for you!" is the ultimate dialogue which never seems to wear out. It makes generations after generations wish for a love of that kind. However, it would definitely be tough for you to believe me if I told you that this theatrical statement has a very interesting psychological explanation behind it. This form of self-sacrificing conduct or 'gut feeling' is called 'Altruism' in the language of science.

'Altruism' by the Oxford dictionary is defined as a selfless concern for the well-being of others or the feeling of sympathy, care and love. In biology, altruism refers to the behavior of an individual that increases the chance of survival of its own kind. Human beings aren't the only self-sacrificing creatures on the planet (a feature evidently not dominant in every individual of the species).

For instance honey bees that make us go wild and crazy, for they might sting us (or at least that's what we suppose), are actually true martyrs when it comes to saving their colonies. They sting the aggressor at the cost of their own lives. After the tedious process of attempting to sting once they finally execute the attack, the sting leaves their bodies, rips their abdomen, and hollows them till the tiny little bee dies.



Mostly extreme cases of altruism are performed by creatures incapable of thinking. From the Darwinian point of view, altruism goes against the 'survival of the fittest' making us question its existence like many other biologists. However, Darwin on further observations concluded that altruism is a form of kin selection. It was observed that in the case of monkeys, a female monkey on seeing a predator gives an alarm call exposing herself to danger while the rest of the group hides, but not all of them risk their lives for others,

similar to the 'bad king-good king' plot. Some monkeys prefer to stay hidden rather than showing bravado.

Now next time if you are the first one to give your dessert away, remember that it's altruism at work!

- Maitreyee Sayyonee (11<sup>th</sup>)

## Hair seems greener on the other side!

I've always wondered about the plethora of reasons for why the folks of the opposite gender at this age, are gifted with impressive levels of IQ. I don't intend to generalize, but it's tragic how I have been acquainted with only those ones! Since I can sense the desperation for an example here, I shall proudly give one. It all began on the 'formal' dinner held with the grade twelve students of Welham Boys' School after the Incredible India Quiz. While I was eating my meal, a boy sitting beside my friend happened to notice the unique colour of her hair( it had been dip-dyed green during the holidays). Widening his eyes and with a face that seemed even more serious than Snape's, he said- " Is your hair naturally green?" Astonished at the stupidity of his question, she began to control her laughter. Then, I explained to him the marvelous theory behind her hair( It's rocket science, believe me). I said that her mother had yellow hair and her father had blue, which inevitably resulted in the birth of a green- haired baby( Yes, I made her an alien for that day). At first he said, "Oh!", but after a while he burst into a fit of laughter! Another time, Mrs. Richa Joshi Pant was convincing her son that my friend's hair was green because chloroplast had been implanted in it. The funniest part is that he questioned her about it, as though there could actually be a possibility!

- Shruti Kaul (12th)

# Busted!

**Fiction : Mice love cheese.**

**Fact :** Scientists have confirmed the earlier research that wild-caught mice do appear to have any apparent preferences for cheese, and probably prefer seeds and grains. Crunchy peanut butter, another common mouse bait was also not preferred. Given that adult mammals tend to have little of the enzyme lactase, required for lactose digestion, cheese probably isn't great for a mouse's health, either. Plus feeding cheese to a mouse is a criminal waste of cheese!

**Fiction : The tongue is divided up into different sections.**

**Fact:** The absence of an umami section is not the biggest problem with the tongue map. The idea that our tongues are split into sections has been perpetuated by textbooks and teachers for decades, yet it has no basis in physiology. The receptor cells that identify the molecules underlying the basic tastes (sweet, sour, salt, bitter and umami) are distributed on taste buds all over the tongue.

**Fiction : You need to drink eight glasses of water a day.**

**Fact :** Being dehydrated isn't great for your health, but the idea that we need to drink eight glasses (around two litres) of water in order to stay hydrated has no real scientific backing. Research suggests that health can be maintained with a much lower water intake. As concluded by Dr. Heinz Valtin from Dartmouth Medical School, there's also no evidence to specifically drink plain water. You can stay hydrated with any other fluids and the water that's found in most food .

**Fiction: Left-brained people are logical, right-brained people are creative.**

**Fact:** As described by the University of Utah's Jared Nielsen in a study of brain scans from over 1,000 individuals, there is no evidence of left- or right-brain dominance. The idea that there are left-brained people who are logical and right-brained people who are creative may be a useful metaphor, but it has no more basis in actual science than astrology does.

## Credits

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