

ISSUE NO. 2

BASIS INQUIRER

THE BASIS SCIENCE MAGAZINE

20

PRETTY COOL
ROCKET MODELS

*Rocket Designs from
1961 to now*

Water on Mars

Check out our magazine for this new
discovery that could change our world
forever



10 Things
You Never
Knew About
Astronauts

The Life of a Star

By: Vignesh Sivakumar

Incinerating masses of hydrogen and helium in space, fusing atoms under extreme temperatures, producing millions of megatons of nuclear energy in a second, destroying or creating planets and solar systems in an instance, stars wield tremendous power throughout their lifespan. The reasons behind their formidable power and even their possible influence on the creation of life forms are currently undergoing extensive study.

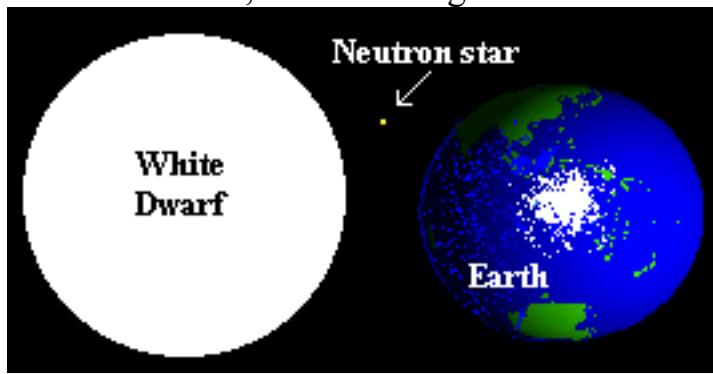
However, what is born must die, and many stars experience a dramatic end.

In the far depths of the universe, clumps of dust and microscopic rocks start to join together in stellar clouds rich in hydrogen. Under the influence of gravity, a clump of hydrogen atoms and dust specs begin accumulating material, a star is being conceived. Once the mass of hydrogen and dust begins heating up with gravity pounding material at it, the soon-to-be star begins to form its own gravitational field, which allows it to enlarge to such measures observed today. Right before the star is born, a core forms under extreme temperatures and the burning of hydrogen into helium begins. With fusion blasting out from the core, the star can sustain its shape into the bright, round, familiar, ball we all know and recognize. This creation process is a ten million year endeavor that yields great things. Thanks to the star's massive gravitational field, extraneous forms of dust and rock form around the star, in a radius the size of a solar system relative to that of the star; these clumps of matter eventually become planets that revolve around it. The star has finally settled, along with its new companion planets. And won't be for million, billions, and perhaps even trillions of years before the star even begins to die. But, when a star does reach death, everything around it will be obliterated.



(The birth of a star)

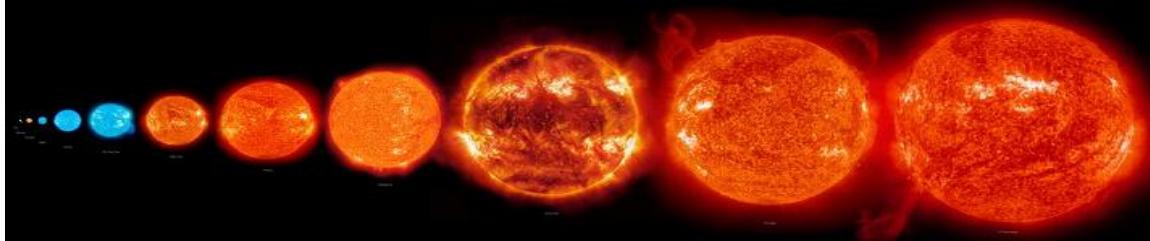
The star has aged, aged, and aged for billions of years. The fusion of an immeasurable amount of hydrogen atoms into helium has accounted for a vast span of time. Now, the hydrogen is close to depletion, and the star is beginning its final phase of life. The helium gets fused into carbon, carbon into oxygen, and so on, creating a plethora of larger elements right in its core. The immense power of gravity begins the star's changing core. In response, the potential energy of fusion builds up in the core, greatly beyond the confines of structural capacity. The star's outer layers are pushed outwards, expanding one hundred times the mass of the star originally. To give an idea of just how much of a growth this is, the sun of our earth's solar system makes up a whopping 98% of the mass in our *entire solar system*. So, a hundred times that is something to think about. The dying star is now a "red giant" and has expanded to lengths well over 100 million miles. Anything in its path of expansion had been engulfed in flames of destruction. Finally, the core, under the most extreme, unstable pressure, explodes, blasting off the outer layers of the star. What remains is a tiny, bright, but hot "white dwarf". The white dwarf is still quite spectacular as it retains much of the solar system's mass, but is so dense that it is only about the size of earth. In turn, its surface temperature can exceed 150,000 kelvins (our Sun's is around 5,800 kelvins). But, it is alone and without planets. Its death inevitable, the star's reign has come to an end.



(Neutron star info later)

What of the gargantuan stars we see in space? Their lives are erratic and highly explosive. Eta Carinea, a bright blue, supermassive star one million times larger than the sun; Betelgeuse, a red supergiant, 100 million times larger than the sun; and Canis Majoris, the largest star ever discovered at over one billion times the size of the sun, all have a shorter life span, burning up greater amounts of hydrogen. These stars may end up in a cataclysmic end, but their death holds the building blocks of life. Supermassive stars start their lives the same way as "normal" ones, but their

temperatures are much larger. These stars can burn at over 100,000 degrees Fahrenheit. The Sun's hottest temperature is only 10,000 degrees Fahrenheit! A typical superstar still lasts for millions of years; however, when these bad boys go out, things start to get a little unstable.



(Our Sun is the first dot on the left, farthest to right being Canis Majoris)

The supermassive star has burned through its storage of hydrogen, and again the colossal power of gravity begins to crush the blasting core at the center. This time no energy can escape the core. Larger elements are produced, and eventually, iron is produced. Iron eats up all of the fusion energy and the core structure can no longer withstand gravity. The star is doomed, in a fraction of a second the core collapses to over one trillion grams per milliliter, and... BOOM! The core explodes violently, blasting off all the star's layers, in an event called a supernova. The shock wave is powerful; it travels at 8 miles *a second* for over 250,000,000 miles into space. In a final, dramatic display of grandeur, the elements built up inside the supermassive star are released, floating freely into space. These elements allow for new stars, new planets, and perhaps even the synthesis of life.



(A supernova)

Daunting, but imagine this: without the death of a star, you and I might not be here and this world might not have existed. We depend on our Sun to give us light and warmth; it is our anchor in the vast ocean of space. Without it, the planets would freeze and hurtle aimlessly through the dark.

But are there instances in which something remains in the wake of destruction? Indeed, scientists have discovered that these supernovas can result in the formation of “neutron stars”. There are two types of neutron stars, pulsars and magnetars, both extremely dense. There are pulsars, and there are magnetars. Among the most exotic and enigmatic objects of matter, neutron stars await further research.

Amazingly, there are stars even larger than supermassives, whose deaths create some of the most iconic yet mysterious heavenly bodies in the observable universe. When a star of such size is being crushed by gravity, the pressure is so incredibly immense that the core is transformed into a black “hole”, or so it is called. Immediately, the black hole begins to devour the dying star around it and blasts out two bright bursts of gamma rays from the black hole’s “surfaces”, as the “hole” is seemingly two-dimensional. These bursts are called a hypernova, one of the brightest phenomena in the universe. The truth is that scientists have almost no information on black holes and what they entail, as their immense gravitational pull sucks in light, rendering the insides of the “hole” itself unobservable.



(A black hole, hypernova subsided)

Black holes. Are they ruptures that break the space-time continuum, allowing time travel, teleportation, or even both? Portals to new spatial dimensions? Or maybe just super death machines that completely obliterate any mass that enter them, defying the laws of physics? These are some of the questions that astronomers today have yet to answer; only so much can be learned from looking through telescopes and speculating about observations. Eventually, humans will have observed everything they can. A time may come when such questions can only be answered with exploration.

10 Things You (probably) Didn't Know about Space

By: Rizwan Mannan

Space, with everything in it, is, without a doubt the largest “thing” we know of. There’s much we haven’t discovered about outer space; however, through extensive research, we have discovered a bit about the worlds beyond ours. Black holes, supernovas, and giant asteroids are now commonly known objects of space, though they still await certain explanations. Astronomers are constantly making new discoveries in the final frontier. Here are 10 things you probably didn’t know about space.

1. There are raspberry and rum gas clouds in space

Scientists have discovered a gas cloud called Sagittarius B2 near the center of the galaxy. Sounds pretty normal. It would be if it were not for the discovery of the chemical ethyl formate. This is interesting because ethyl formate gives the smell of rum and the taste of raspberries, so scientists have essentially managed to find a giant vein of raspberry flavored rum gas in the core of the galaxy. Sounds pretty tasty, right?

Nope. The gas is also extremely poisonous. Aside from the scary vacuum of death that is space, there is a chemical, propyl cyanide, in the cloud that would dissolve your organs, the remains of which you would vomit out. Not quite as appetizing anymore.

2. Scientists discovered the brightest matter in the universe

We’re talking about quasars. When two black holes merge, they usually form a bigger black hole. However, when they collide at an angle, the accretion disk (the large disk that surrounds a black hole) starts to spin extremely fast and glow a bright white, as the black hole lets out many megatons of energy per second in the form of Gamma rays, that shoot out of the top and bottom. That’s what we see as so bright and so beautiful. These beauties could also incinerate the solar system in less than a second.

3. There are stars made of diamond

Scientists have discovered a star that is so cold it has crystallized into a giant chunk of diamond. This ancient dwarf is unfortunately not

visible through telescopes, but the 11 billion year old star is actually as large as earth. Researchers say that there may be more of them studded throughout the galaxy. Wouldn't mind that one of those on a wedding ring.

4. A planet made of burning ice

There is a planet completely made of burning ice. Sounds like something straight out of Star Trek, right? Not anymore. Gliese 436 b is so close to its sun that the surface is always 800 degrees Celsius. But where's the ice? The gravity of the star causes all of the water vapor to be compressed into a solid, cold mass of ice... on fire. But if you think it would be a weird, interesting sensation to touch, you should know the surface would freeze and disintegrate your hand instantaneously. Ouch.

5. Beware the planet from hell

Ironically, 'the planet from hell' is thought to be the most habitable for humans. For starters, it orbits a red dwarf star, so the sky is always crimson red. Now aside from this difference, the red light also means that all plants are would be pitch black. And there's yet another weird thing about this planet. It is so close to its star that it doesn't rotate at all, meaning, half the planet is always in frozen darkness, and the other half is scorched black rock. But it's not all bad because in between these two sides, there's a nice ring of livable land at just the right temperature where we can live on. So to summarize: red skies, black plants, if there was any life at all, and death by incineration or freezing on either side. But that middle part, though. That's the place to be.

6. Cosmic cannibalism. It's a thing

Galaxies can actually "eat" other galaxies, sort of. It doesn't involve stars or planets mushing together, but the whole gravity situation gets rather disorganized. Black holes at the center of each galaxy merge into a larger one: the larger black hole engulfs the smaller one, and as a result, the solar systems get moved out of alignment. It usually is an example how galaxies can bulk up and 'evolve' over time. Our galaxy, the Milky Way, is on its path to merge with our neighbor, Andromeda. But don't worry; it won't happen for a few million years.

7. Oldest water in the universe

Scientists have discovered the oldest and largest mass of fresh water in the entire universe. This giant water vapor cloud surrounds a massive black hole and has 140 trillion times more water than all of earth's oceans combined. But don't get too excited, California, because this water is 12 billion light years away.

8. You can see another galaxy in the sky

You can actually see the Andromeda galaxy from Earth. However, you have to be positioned in a place where the sky is clear and artificial lights are not present. It looks like a distinct blurred yellow blip in the sky. Unfortunately, it is not visible from Phoenix and the closest area of visibility is in the Australian outback. So, yeah, just Google it.

9. Space Bears

Believe it or not, some animals can actually survive in space. And no, we haven't discovered a space whale swimming through the stars. A micro animal called a Tardigrade, or water bear, is capable of thriving in extremely harsh conditions. It can survive in the vacuum of space for years, temperatures well above 100 degrees Celsius, pressure 6 times the amount of the deepest water trenches on Earth, and radiation far more lethal than other known organisms can handle. Take that, cockroaches – just surviving nuclear fallout won't cut it anymore.

10. There's a trillion lightning bolts in space

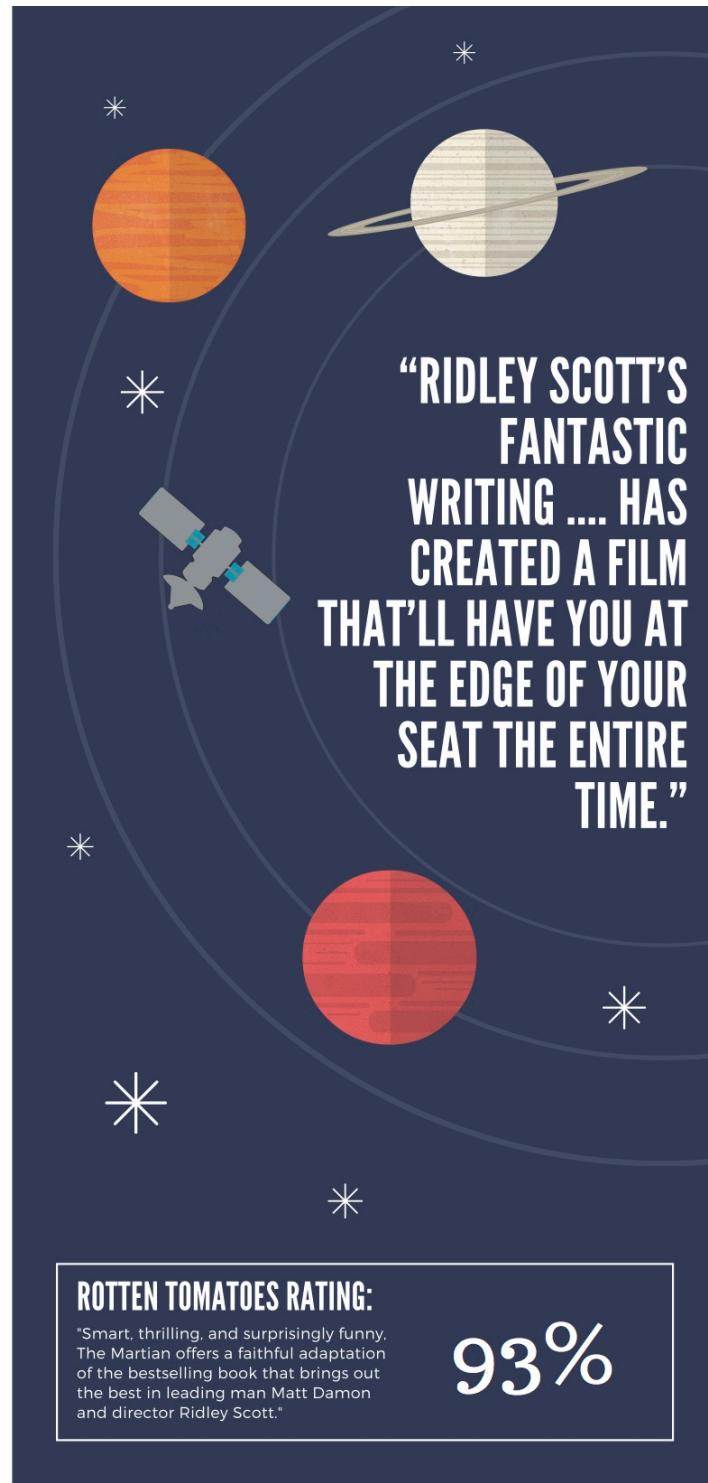
A giant electric current has been found in space. A cosmic jet of energy 2 billion light years away is carrying the highest electric current ever observed: about 1 trillion bolts of lightning. It is believed that magnetic fields from a colossal black hole at the galaxy's core are generating the current. This electricity would be more than enough to sustain Earth's needs for over 100 billion years if we could harness it (which we can't). So unfortunately for now, we'll still have to suffer power outages when we use the toaster and the kettle at the same time.

THE MARTIAN REVIEW

By: Archit Chopra

Ridley Scott's cranked out numerous blockbusters over the years such as Black Hawk Down, Gladiators, and Blade Runner, but the 77 year old shows no signs of slowing down with his newest film, The Martian. The film does not have the intricate complexity of Interstellar that leads to an mind-shattering revelation, yet the Martian is has been welcomed as an addition to the science fiction genre. Most of the Martian's appeal originates from an astronaut using scientific knowledge to get out of never-ending problems in a fashion similar to Gravity.

Ridley Scott's fantastic writing accompanied with Matt Damon's superb acting as Mark Watney has created a film that'll have you at the edge of your seat the entire time. Every time it seems as if all problems have been solved, another problem appears and ends up causing more complications. The only odd characteristic in this movie is Watney's admirable kindness and the cliché happy ending to every problem in the movie. Regardless of its flaws, however, it's one of the best movies of the year.



Water On Mars: An Extraterrestrial Discovery

By: Jerry Miao

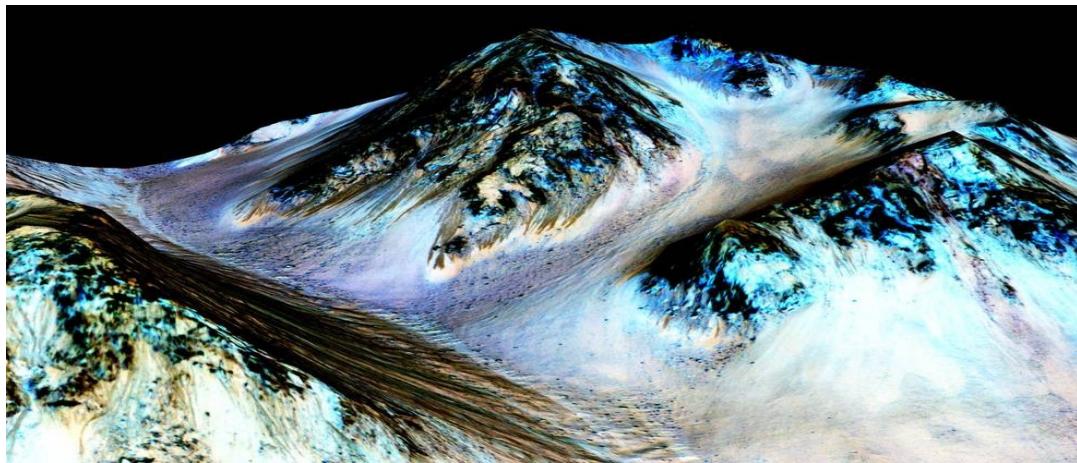
A decade ago, the phrase “water on Mars” would sound foreign and unbelievable. However, modern science and astronomy is advancing at a breakneck speed. On the 28th of September, NASA gave a press release detailing the recent discovery of flowing liquid water on Mars.

That’s right. Not water a billion years ago, not a mysterious liquid that may or may not be poisonous to humans, but *actual flowing water on Mars at this very moment*. However, it’s not quite the kind of water you would see in a river or lake.

According to the press release on nasa.gov, the National Aeronautics and Space Administration used an imaging spectrometer to detect “signatures of hydrated minerals on slopes where mysterious streaks are seen” on Mars, as depicted by the image above. The briny streaks are formed by water interacting with perchlorate crystals, which enables the water to flow downhill.

In the future, NASA will make their best efforts to avoid contaminating the Red Planet with microbes from our own planet Earth. Thereby making “wet areas the most difficult to visit”, NASA will have to exercise extreme caution when making any further research. Their current plan is to observe the source where the water flows from, which is currently suspected to be porous rocks under the surface of Mars.

Sorry to anyone who anticipates purified bottled Martian water anytime soon. Unless briny, muddy water with the side of hydrated perchlorate crystals is sufficient. In that case, you’re in luck.



The dark streaks on the sides of these hills on the Red Planet are formed by flowing water.

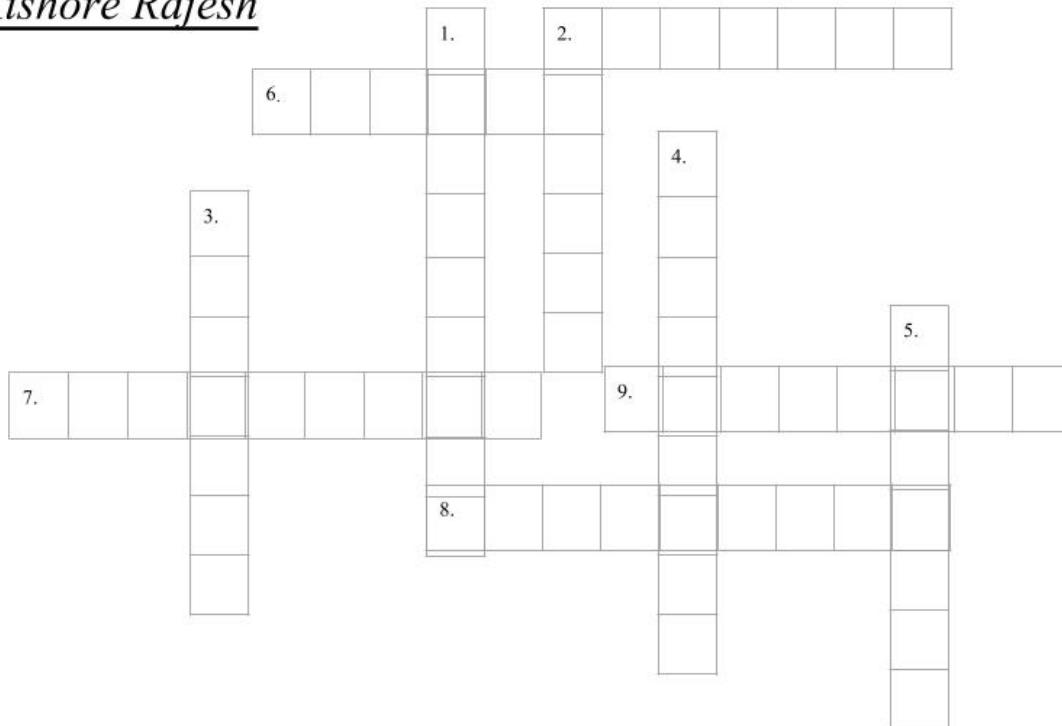
THE ORIGINS OF ASTRONOMY

By: Kishore Rajesh

Astronomy is the oldest science that has been a fascination for as long as humans have walked this earth, originating independently in Egypt, India, China, Mesopotamia, Greece, and South America around the same time. The ancient Egyptians around used astronomy for predicting when the Nile would flood, when droughts were imminent, and for predicting other things. In Ancient China, an astronomer, Shi-Shen (think Rush Hour), mapped over 800 stars and 120 constellations. The ancient Indians created a calendar with 360 days and 12 months, each with 30 days.

The ancient Babylonians used the sun and moon to create a calendar that helped them predict solar and lunar eclipses. Later, when the Persians conquered the Babylonians, the separate cultures and ways of thought became intertwined. (Note: The Persian ideas would influence Islamic scholars in the eighth century CE, a thousand years later) However, when Alexander the Great conquered the Persians, these astronomical ideas found their way into Greece. Ancient Greek science even proved that the earth is round. Pythagoras (you probably know him better for his theorem), a man of science, noticed that as ships left Greece, the boats faded away into the horizon, proving that the earth was a sphere. Eratosthenes, the first Greek geographer, measured the circumference of the earth. He realized that the earth was round, based on angles formed by shadows.

Unlike the Babylonians, the Greeks imagined a model of the universe. Aristotle was a Greek scientist, and a philosopher and lived around 350 BCE, who imagined the earth as the center of the universe and the moon, the Sun, and all the planets and heavenly bodies revolving around it. Ptolemy, the infamous Greek ruler of Egypt, believed Aristotle's version of the universe. However, Copernicus, a Renaissance astronomer, in 1473 CE, came to the conclusion that the sun was the center of the universe, that it never moved, and that all the planets revolved around *it*. But, little did he know, in 476 CE, about a thousand years before Copernicus, an Indian astronomer, Aryabhata, originally proposed the heliocentric theory and that the moon reflected the sun's light. These two theories are scientifically designated as the geocentric and heliocentric theories, respectively. However, they are both wrong; the earth is not the center of the universe, and neither is the sun. Copernicus was right in thinking that the planets orbit the sun, but the sun does move around the Milky Way.

Astronomy Crossword**Kishore Rajesh****Down**

1. Explosion of a star
2. When the moon is more than half, but less than full
3. When both day and night take up the same time
4. Ancient pseudoscience related to astronomy
5. The star that seems to stay in place all year; "the north star"

Across

2. Cluster of dust stars and gas
6. Center of a galaxy
7. Energy from a star
8. The nearest galaxy to the Milky Way
9. Lets you time-travel through space

The BASIS Inquirer Staff

Editors: Alonzo Arambulo, Anamika Basu, and Jerry Miao

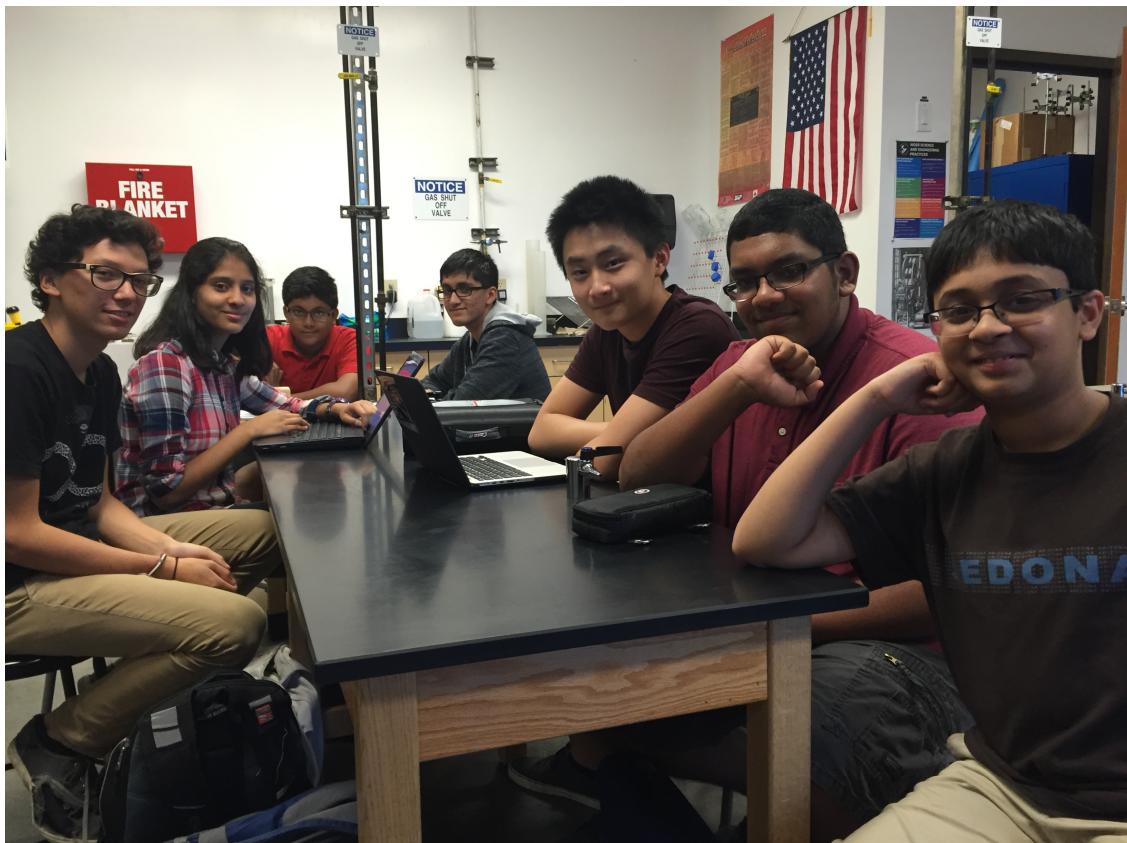
Graphic Design: Alonzo Arambulo, Anamika Basu

Page Layout: Alonzo Arambulo, Jerry Miao

Lead Coordinator: Jerry Miao

Faculty Advisor: Ms. Cooney

Journalists: Vignesh Sivakumar, Alonzo Arambulo, Archit Chopra, Rizwan Mannan, Devon Harris, Anamika Basu, Kishore Rajesh, and Jerry Miao



Next Issue: Beware the Deep!