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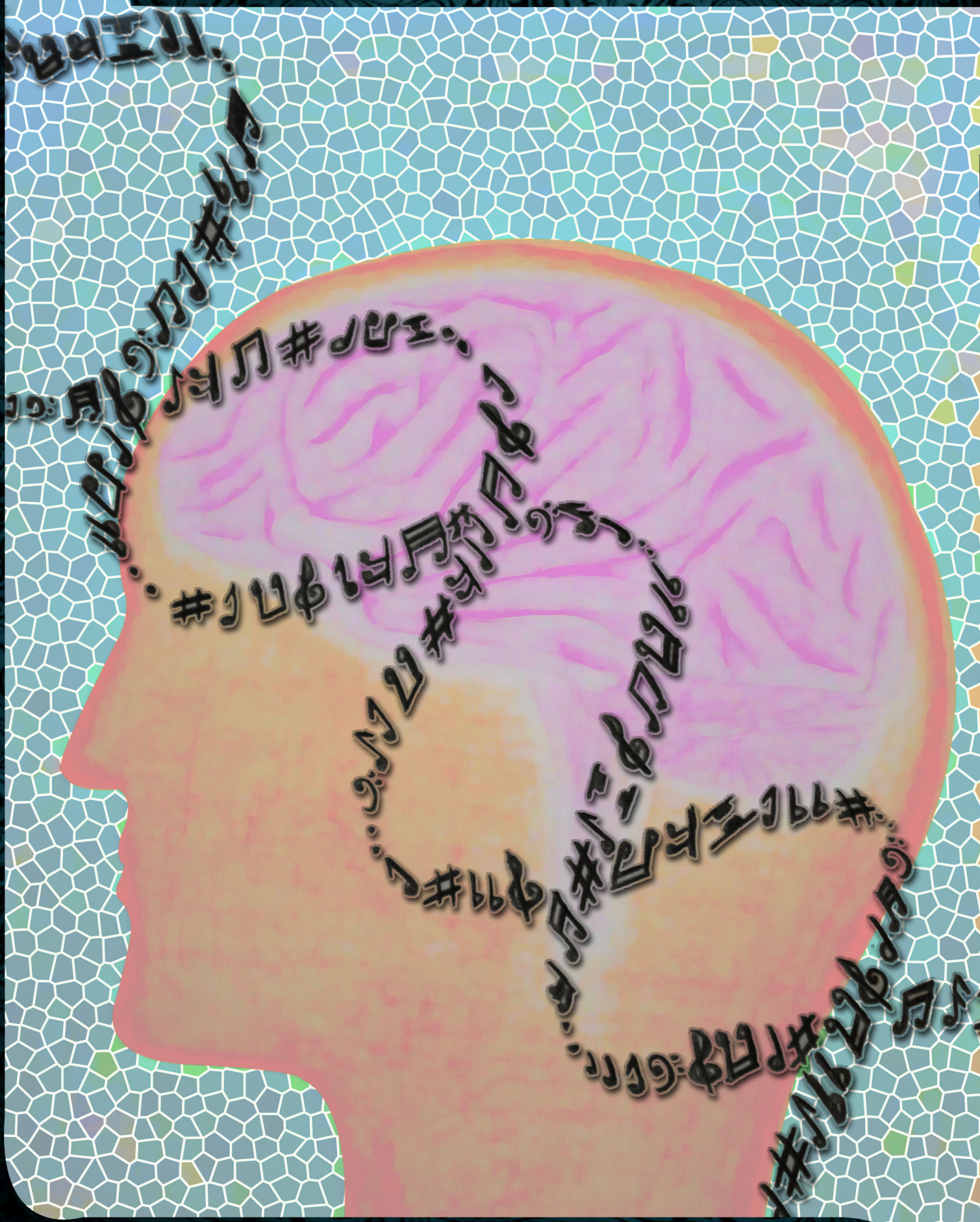
The Anveshna Newsletter



LETTER FROM DIRECTOR

The scariest moment is always just before you start - Stephen King

Our daily attempt in creating a world class facility to learn has evolved from various ideas and serious involvement of people in creating and disseminating knowledge to the world.

In the information and communication era, the creation and sharing of knowledge is almost unified and have no boundaries. The idea of creating a knowledge repository by capturing the various activities and empowering the students to pen down their learning through this medium is very much appreciated.

When you look out for a good write-up on something and if it is not available, then the best thing to do is to write one. The exorbitant potential of the youth will reveal more mysteries in science, technology and social well being.

I wish this e-resource to create volumes of knowledge and the team's every step, in bringing this to light, all success.

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Science of Melody

Many have experienced the sensation of goose-bumps while listening to certain pieces of music. Be the genre classical, orchestral or jazz, the 'shivers down your spine' sensation has always intrigued scientists.

So, here's the big question. How, or rather, why do simple things like sound waves and basic harmonic frequencies manage to generate such a response? Researchers, over the last few decades, have been able to work out a few answers, giving rise to yet another field in the realm of Neuroscience; Cognitive Neuroscience of Music

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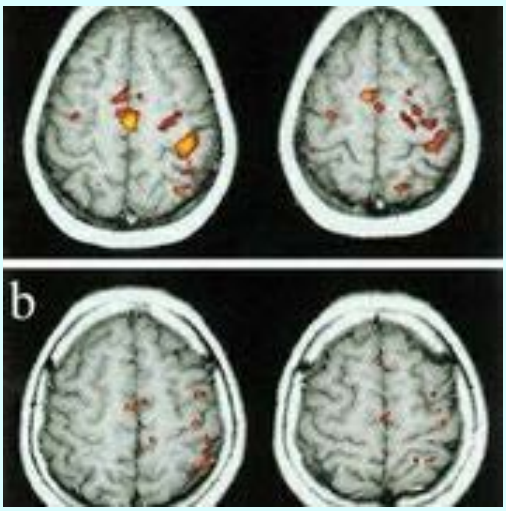
Brain differences between Musicians and Non-musicians:

The first steps taken in the field of cognitive neuroscience of music, was to identify any structural or pathway differences between the brains of musicians and non musicians.



In (a), two consecutive slices of a control subject (#1) during complex finger movement of the right (dominant) hand can be seen; (b) demonstrates two similar slices of a piano player (#2) during the same task. Activation patterns in differ, showing that musicians require a 'lower' level of brain activation to perform similar motor tasks, compared to non musicians

Krings et al. (2000)[1] compared fMRI brain scans to study brain area involvement of professional piano players and a control group while performing complex finger movements. Krings et al. concluded that musicians' brains showed much lower levels of cortical activation in motor areas of the brain compared to non-musicians. . It was concluded that a lesser amount of neurons needed to be activated for the piano players due to long-term motor practice which results in the different cortical activation patterns.

Koeneke, Lutz, Wustenberg and Jancke (2004) [2] conducted a similar study on keyboard players. Skilled keyboard players(Group 1) and a control group(Group 2) performed complex tasks involving unimanual and bimanual finger movements. While undertaking these tasks, strong hemodynamic responses in the cerebellum were shown by both non-musicians and keyboard players, but non-musicians showed the stronger response. This finding indicates that different cortical activation patterns emerge from long-term motor practice. This evidence supports previous data showing that musicians require fewer neurons to perform the same movements.

Burriss et al.[3] reviewed work by Cowell and Schlaug, publishing a review paper in 2001. They stated that musicians have been found to have more developed anterior portions of the corpus callosum in a study by Cowell et al. in 1992 (fMRI scans). The corpus callosum is essentially the line of communication between the two cerebral hemispheres. These fibers connect the left and right hemispheres of the brain and indicate an increased level of co-ordination between both sides of the brain. This suggests the merging between the spatial- motion-tonal processing of the right brains and the linguistical processing of the left brain. This extended communication across different areas of the brain might contribute to musician's ability to aid in memory function and general co-ordination..

Studies by Cowell et al., were confirmed by a study by Schlaug et al. in 1995 who found, additionally, that classical musicians within the age group of 21 and 36 have a greater anterior corpora callosa than the non-musical control population.

Gaser and Schlaug (2003)[4] compared brain structures of professional musicians with non-musicians and discovered gray matter volume differences in motor, auditory and visual-spatial brain regions. Specifically, positive correlations were discovered between musician status (professional, amateur and non-musician) and gray matter volume in the primary motor and somatosensory, premotor areas, anterior superior parietal areas and in the inferior temporal gyrus bilaterally. This strong association between musician status and gray matter differences supports the notion that musicians' brains show use-dependent structural changes

Musicians: A breed 'born', or 'made'?

Having confirmed a structural difference between the brains and neural networks of musicians/non-musicians, a new question must be asked. Are these musicians made, or are they born with higher levels of cognitive reasoning? It was of a general opinion, that music influenced those who were trained to hear it, but not to those who were untrained; a theory eventually disproved by Sheila Woodward (University of Capetown), who's studies convinced the scientific community that even a foetus, responded to music, while still within the womb.

It certainly wasn't known whether we could hear and respond to music before birth until the groundbreaking research of Woodward, who wanted to know more about musical sound in the womb during her own pregnancy in the early 1990s

Sheila Woodward's Experiment:

At University of Capetown, Woodward worked with the Institute of Maritime Technology to adapt an underwater microphone so it could be placed in the uterus.

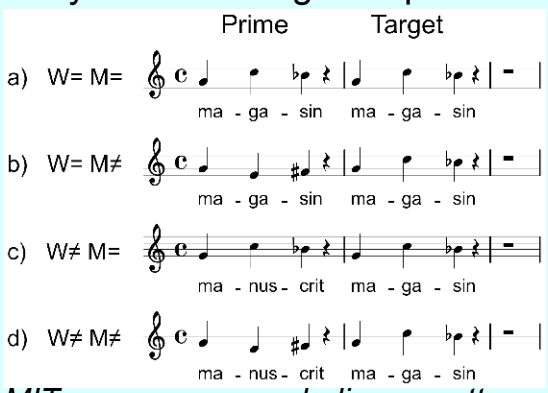
The tiny waterproof hydrophone, about two inches long, was found to be safe enough by doctors to be placed within the womb. As part of Woodward's research, this miniature microphone was inserted through the cervix into the uterus of a mother in early labor and placed alongside the unborn child. The mic recorded what was audible inside the uterus while Woodward played music, sang herself, and had the mother sing.

The first sounds detected by the mic, were the sounds of a steady 'thump' producedthe uterus while Woodward played music, sang herself, and had the mother sing.

The first sounds detected by the mic, were the sounds of a steady 'thump' produced by blood flow through the uterine wall. Woodward describes a landscape of musical sound, which does indeed surround the foetus. Along with the natural womb sounds, one could also hear the strains of a Bach Brandenburg Concerto being played, or the melody of "Mary Had a Little Lamb" as Woodward sings in a normal tone of voice.

The recordings show that the very high frequencies, like the sharp attack of an instrument, are attenuated and sound a bit muffled. The overall effect is like listening to music underwater. But when listening to the human voice, one can still detect whether it's a woman or a man. And the timbre of the voice comes through.

The 'startle response' of the foetus was measured as well, and Woodward's team found that when music is played, the foetal heart rate becomes slightly elevated. Woodward says it was clear that the foetus reacted. Other studies show that even if only the mother hears music – if she has headphones on, and it is music that she finds pleasant – the baby's heart rate lowers while the mother is listening. If the mother finds a certain piece of music stressful , the baby's heart rate goes up. It can pretty much be inferred that the foetus can echo the mother's response to music.
The work conducted by Woodward et al., is documented by Elenna Mannes, in her book 'The Power of Music' [6].



MIT uses melodic patterns to stimulate verbal recognition and memory capacity.

Music Therapy: The future for Neuro-degenerative disorders?

A relatively modern technique known as melodic intonation therapy (MIT) uses music to coax portions of the brain into taking over for those that

are damaged. In some cases, it can help patients regain their ability to speak.And because of how we associate music with memories, Mannes says such techniques could also be helpful for Alzheimer's patients.

Aphasia: Studies by Anna Zumbansen, Isabelle Peretz and Sylvie Hébert were published on 9th January 2013, in the Frontiers of Neurology. The article, titled 'Melodic Intonation Therapy: Back to Basics for Future'. Zumbansen et al[5]. presented a critical review of the literature on MIT as one of the most formalized treatments used by speech-language therapist in Broca's aphasia. This disorder is characterised by the loss of language, verbal or written. The goal of MIT is to restore propositional speech. The rationale is that patients can learn a new way to speak by using music to stimulate language-capable regions of the right cerebral hemisphere.

The Music Therapy Trust, India, is taking advanced steps, bringing music therapy to the forefront of autism related therapy.

Autism Spectrum Disorders: A peer reviewed article 'Considering sensorimotor needs of persons with autism spectrum disorders', published by Hardy, M. W. & La-Gasse, A. B. (2013)[7] (in press) directed music therapy towards Autism Spectrum Disorders(ASD). Their studies revealed cortical and cerebellar differences in autism, with suggestion of early cerebellar dysfunction. In order to combat this they proposed the use of Rhythmic Therapy, to revive lost sensorimotor needs of ASD individuals. The paper, reveals how rhythmic input can improve sensorimotor func tioning, thereby allowing individuals with autism to demonstrate their full cognitive, behavioral, social, and communicative potential.

Though the field of cognitive neuroscience of music is quite young, it has already been made of use, for the treatment of neurodegenerative disorders. Perhaps further research shall provide stronger associations regarding music's influence on neural networking.

There exists a common phrase; "This song touches me". Well, I believe that statement is quite literal. Even within the womb, the sounds of natural rhythm: heartbeat, pulse and breath, can be heard. These pre-natal influences could teach us how to enhance cognitive reasoning in toddlers, or even reverse the process of memory loss in aged patients. Many links are yet to be unveiled; we are only limited by our own ingenuity.

References:

[1] Krings, Timo; Töpper, Rudolf; Foltys, Henrik; Erberich, Stephan; Sparing, Roland; Willmes, Klaus; Thron, Armin (2000). "Cortical activation patterns during complex motor tasks in piano players and control subjects. A functional magnetic resonance imaging study". Neuroscience Letters 278 (3): 189–93. doi:10.1016/S0304-3940(99)00930-1. PMID 10653025

[2] Koeneke, Susan; Lutz, Kai; Wüstenberg, Torsten; Jäncke, Lutz (2004). "Long-term training affects cerebellar processing in skilled keyboard players". NeuroReport 15 (8): 1279–82.doi:10.1097/01.wnr.0000127463.10147.e7.PMID 15167549.

[3] Burriss, Kathleen Glascott; Strickland, Susan J. (2001). "Review of Research: Music and the Brain in Childhood Development". Childhood Education 78 (2): 100.doi:10.1080/00094056.2002.10522714.

[4] Gaser, C; Schlaug, G (2003). "Brain structures differ between musicians and non-musicians". The Journal ofNeuroscience 23 (27): 9240–5. PMID 14534258.

[5]Zumbansen A, Peretz I and Hébert S(2014) Melodic Intonation Therapy: Back to Basics for Future Research. Front. Neur. 5:7.doi:10.3389/fneur.2014.00007

[6]The Power Of Music: The Science of Song-Elenna Mannes, published by Bloomsbury Publishing

[7] Hardy MW and LaGasse AB (2013) Rhythm, movement, and autism: using rhythmic rehabilitation research as a model for autism. Front. Integr. Neurosci. 7:19. doi: 10.3389/fnint.2013.00019 Received: 01 December 2012; Accepted: 10 March 2013;

[8] Words and Melody Are Intertwined in Perception of Sung Words: EEG and Behavioral Evidence Reyna L. Gordon, Daniele Schön, Cyrille Magne, Corine Astésano, Mireille Besson Published: March 31, 2010, DOI: 10.1371/journal.pone.000988

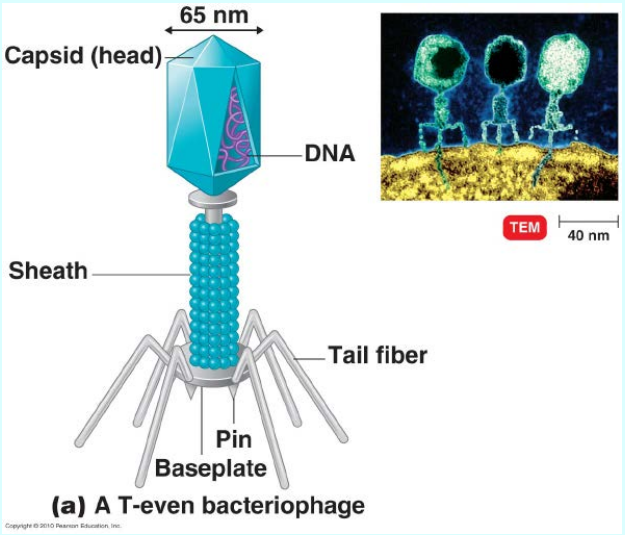
Jacob Antony Alappatt
3rd Year BTA

Virus : The Formidable Foe

As Human beings, irrespective of differing lives we all encounter one thing - the common cold. The word common has been used with good reason too. Little do we know that every time we get sneezed or coughed on, that a potential battle between our cells and an ancient enemy has begun. Viruses have existed for as long as any living cell has on this planet but they still continue to have a profound effect on complex multicellular organisms. In the race of evolution and survival of the fittest, organisms have been wiped off the face of the planet and new bizarre organisms have risen, but through all these billions of years the viruses have stayed steadfast in their survival. Viruses are the most unique arrangement of elements and one of chemistry's weirdest portrayals. The reason behind such a description is because one can still not be sure about calling it a life form. We shall explore the contemporary world of the virus by the end of which I hope you understand why.

The Journey Begins :

When viruses first come in contact with a human, they are faced with our first line of defence, the skin. It's one of our major mechanical barriers which have other significant functions too but the skin is not fool proof. The viruses use our body cavities (buccal cavity, nasal cavity, etc) to burrow into us where they encounter greater threats like our cilia and mucosal secretions that entrap them. About 60% of the total virus invasion is eliminated in this manner. The lucky ones continue on to find themselves a host cell. The goal of a virus is to get into a cell's nucleus so that they can reproduce their viral machinery. Our body though is a result of 4 billion years of evolution so the task at hand for these viruses is a trying one. The moment the virus army reaches the tissues extracellular space they are met by a hail of Y-shaped antibodies that are the body's infantry. The antibodies latch onto them and accumulate viruses via crosslinking so that they fall easy prey to white blood cells. Antibodies also alert proteasomes which are protein degrading machines that rip the virus and its protein shell to shreds. Regardless of this Blitzkrieg, some of the viruses survive the initial onslaught and reach the cell surface where they apprehend their next obstacle, extracellular and integral membrane proteins. The proteins move around in the fluid-like lipid membrane acting as the cell's sentinels guarding it from foreign invaders. The cell membranes porosity allows small molecules like oxygen and water to seep through merely using



their concentration gradients. Other substances like ions (Na+,K+ etc) have special ATP dependent pumps to transport. So what does the virus do in such a fix? Does it give up? No. They improvise. Over the years, most viruses have fashioned their tail fibers to bind to these cell sentinels and fool them to bust into the cell.

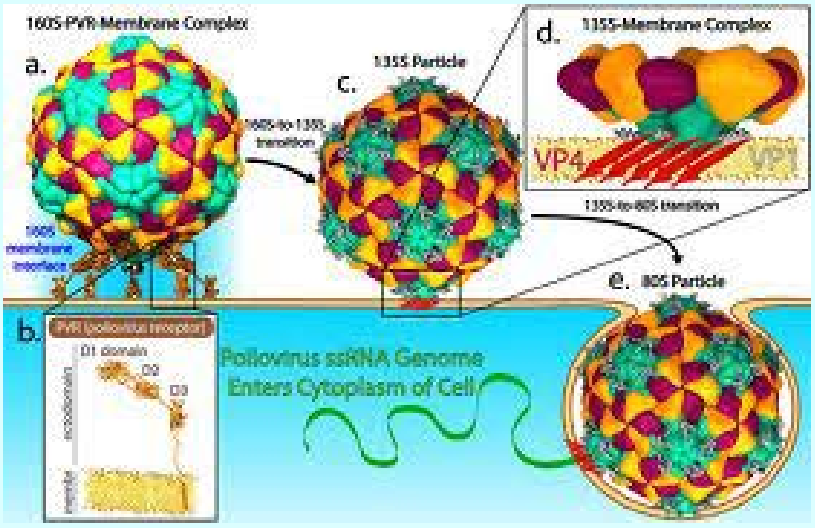
Entry Into The Cell :

The cells, thinking the virus is an important nutrient, opens their vesicles up to invite them in. The vesicles surround the virus forming a protective layer. At this point, Round 2 goes to the virus and they might think they have won but celebrations are not in order because what awaits them is a trip to the cells intimidating sorting station, the endosome. Within the endosome specialized pumps spray the virus with an highly acidic bath that begins to eat away at it. Just when it looks like their journey has come to an end the viruses pull out another card. When its protein shell disintegrates, hidden beneath is another penetration protein that moves out to puncture the endosomal membrane, releasing the virus back into the cell cytoplasm. This situation is a prime example of a true parasite that uses the body's own mechanism against it. Now, most viruses are unable to find a way to propagate themselves further towards the nucleus and therefore they remain suspended in the cytoplasm unable to infect the cell. Some viruses though, over the years, have learned to adapt. Staying true to their nature they bind to the cells own motor proteins. Motor proteins (myosin1, myosin2, kinesin, etc) are ATP hydrolysis dependent proteins that traverse the lengths of the cell cytoskeletal framework carrying baggage for transport from one point to another. When the virus binds to a motor protein, the protein begins to move, hauling the virus towards the nucleus and in a way the cells own demise. The cytoskeletal fibres are like National Highways. They have a lot of traffic and many blocks with 'TAKE DIVERSION' signs. As motor proteins are only capable of unidirectional motion, most viruses stop halfway because of physical obstacles like other intersecting and overlapping fibers. This is a difficult situation for our invaders indeed, but ancient as they may be, viruses have also developed into equally wise entities. The virus binds to a second motor protein that can help it move in opposing directions, thus helping the virus navigate around the obstacles. Now let's have a body count. Out of the million or so viruses that invaded the body, the numbers have now been reduced to a mere few 10's.These viruses have achieved what a million others could not. Complete a treacherous journey filled with mine fields and booby traps to finally reach the nucleus, the control centre of the cell.

The Nucleus :

The morphology of the nuclear membrane is a little different from the cells membrane. They have unique nuclear pore complexes that carefully monitor what goes

in and out of the nucleus (eg .ribosomes, ribozymes, mRNA, etc).Viruses in general are larger than the nuclear pores so their entry into the nucleus hits a road block. It's safe to assume that in their place we would be disappointed having made such a long tedious trip just to see it go in vain, but viruses don't give up that easily. When the nuclear pore proteins bind to the virus at one end and pull trying to get the virus in, the motor proteins pull the virus in the opposite direction. The tension obliterates the viral protein shell into small fragments. This looks disastrous for the viruses but infact, this is another one of their brilliant hatches. When the shell breaks, the viral DNA which is small in terms of girth is able to enter the nucleus via the pores and there, it uses the cells RNA polymerase to transcribe itself into mRNA.In the case of viral RNA,the RNA gets reverse transcribed to form cDNA(complementary DNA) which then gets transcribed to viral mRNA and subsequent viral peptides.Due to the delay between transcription and translation, the cell has one last chance to save itself and its neighbouring cells. Transport proteins carry fragments of the viral peptide via the cytoskeletal highways and surface at the cell membrane waving the red flag and presenting the viral peptide to the leukocytes. This in turn alerts an army of leukocytes and antibodies to the site, killing the infected cell and saving the surrounding healthy cells from infection. In a case where the cell is unable to cry out for help, the viral assembly is completed within the nucleus and over 10,000 new viruses using plain brute force to blast out of the nucleus and cell to go and infect new hosts.



A Perception Check:

Thus this epic exchange of wits has concluded and it is hard to think that all this may be happening in our body this very moment. The battle maybe over, but with our body's ever evolving immune system and the capacity of viruses to adapt, the war is not won just yet. This 4 billion year old cat and mouse game between two arch rivals have helped shape most of what we see in the living world today. When we are spoken to about viruses most of us have expressions of disgust and hate given what

they can do to us. The idea of a single nano sized entity that is capable of bringing down a complex multicellular species such as ourselves strikes fear in most hearts but we must also realize that we are what we are because pathogens like bacteria and viruses have shaped us so. Nature will decide at some point like it always has, as to who lives on and who has outstayed their welcome on this planet we call earth. Till then, the Game will go on.

SITES OF REFERENCES
1.www.ucmp.berkeley.edu/alllife/virus.html
2.Molecular Cell Biology – Lodish and Baltimore

N. Sanjay
2nd year BTA

The Blood Drive

As we all know, there was a blood camp held within our department, earlier on in February 2014. The event was the result of an idea proposed by A.K. Arasudurai, a fellow second year of the B. Tech Biotechnology Branch. We decided to interview him, and get an inside view as to why he conducted this event.

1. What got you interested in organizing such an event?

Recently, a friend of mine met with an accident and we went through a lot of trouble to acquire the blood. This incident made me feel that the patients suffering from such incidents deserve to get blood immediately. And of course, the only way to do this was to collect vast amounts, through a blood drive.

2. Out of all the charity drives possible, why a blood donation drive? Any specific reason?

Since it is a life saving cause we chose this charity program. Giving blood and donating organs are amongst some of the most humane acts of charity.

3. Whom did you involve for the organization of this event? Were you supported by those you approached?

I managed to involve quite a few people. Most of my classmates, friends, juniors, some faculty members, and also, a few members of the medical staff were called upon to help. They all were excited at the idea and did their fullest to help me in this cause .

4. Do you plan to hold any other socially productive events? Could you specify a few, and what kind of help you would need?

In-order to reduce the road accidents we are planning to organize road safety events like that can inform people on the importance of wearing helmets, adhering to speed limits, following traffic rules, etc. It is mportant to note, that in the last three years, there have been 9 students from the batch of 2015 that have passed away due to road accidents, on the college highway.

5. Any words of advice for your peers with regards to social work?

Working for a social cause will earn you blessings. The youth today are spending a lot of time on Facebook WhatsApp etc. We have become a ‘Tech Generation’, which may be advantageous in some ways, but we mustn’t lose our sense of social service.

Instead we can conduct such noble cause and help the people around us .

We encourage all students who possess any ideas of the like, to approach your seniors, or any staff members whom you share a good pally with. Conducting events to raise funds for charity, or simply spreading awareness and education must be one of our primary goals. As such, we would like to conduct socially productive events as often as possible, and request all our fellow students to be active participants.
The Anveshna Committee is proud to have students such as A.K. Arasudurai in our midst. Social service is very important, and must be a cornerstone of our being. Hopefully, we'll find a few more enlightened souls very soon.

Keshavan & Kalaiarasan
NSS Convener
2nd YR BTC

ABOUT ANVESHNA

"Anveshna" thrives upon its aspiration to augment the students' flair in their – approach towards novel research, writing skills, interpersonal skills, managerial skills, community outreach ability, and the like.

Altogether 'Anveshna' is a forum - by the students and for the students - guided by the intelligentsia of - the **Department of Biotechnology, SRM University.**

Our motto is to **"Imbibe. Innovate. Inspire."**

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