

THE

PARTICLE

Syed Babar Ali School of Science and Engineering's Magazine

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SNOW PACKED NORTH

INVESTIGATING SNOW THAT
FEEDS AN ENTIRE COUNTRY



IN THIS ISSUE

DEPARTMENT OF LIFE SCIENCES

There's a new name for the
Department of Biology

BREATHING A NEW FUTURE INTO OUR PAST

A team of scientists and researchers
at LUMS is bringing our heritage to
life through digitization

ایک ہنرمند تخلیق کار



Syed Babar Ali
School of Science and Engineering





■ Dragon Fly Close-Up

A dragon fly sitting comfortably on a taut string. They, like the gigantic pre-dinosaur griffinflies, lack the ability to fold their wings up against their bodies like modern insects do. Today, some 3,000 species of dragon fly are extant around the world.

Image credits

Abdul Mateen (A. Mateen Aviation Photography).

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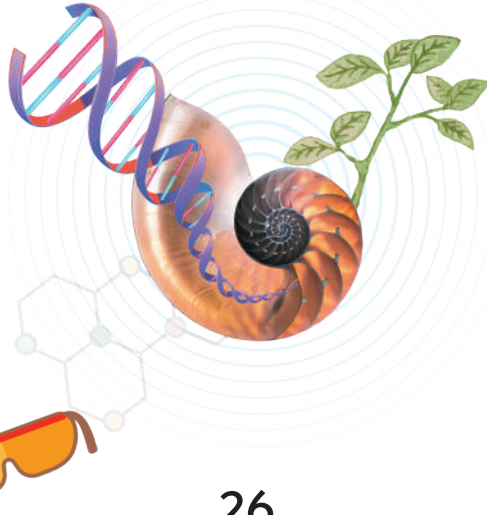
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شعاعِ آرزو

مایوسی ایک ایسی ذہنی کیفیت ہے جو انسان کو آگے بڑھنے سے روکتی ہے۔ مایوسی مزید مایوسی کو جنم دیتی ہے اور تعلیمی اداروں میں افسردگی، پڑمردگی اور مایوسی تو اور بھی خطرناک ہوتی ہے۔ یہ اُمید ہی تو ہے جو اگلی منزلوں کا سُراخ دلاتی ہے۔ رستہ کیسا ہی کٹھن کیوں نہ ہو، خوشدلی اور شکرگزاری کے جذبات انسان میں عمل کی تحریک پیدا کرتے ہیں اور وہ مایوسیوں کے اندھیرے کو چھانٹتا ہوا، ظلمتوں کے بادلوں کو چھیرتا ہوا روشنی اور ترقی کی شعاعوں کو رستہ دیتا چلا جاتا ہے۔

لمز سکول برائے سائنس اور انجینئرنگ میں ہم یہی آس دل میں لیے سرگرداں ہیں کہ خوشحالی ہمارا مقدر بن سکے، علم اور آگہی کے خزانے ہمارے ہاتھ آسکیں اور ہمارے اساتذہ اور شاگرد اگر دو چھائے مہیب اندھیروں میں ترقی اور روشن ضمیری کی شمعیں جلائے رکھیں۔ پارٹیکل کا زیر نظر شمارہ ہماری ان اُمید افزا کوششوں کا خوبصورت آئینہ ہے۔ آئیں! اس جامِ جہاں نما میں فردا کی خوبصورتی تلاش کریں۔

محمد صبیح انور

ڈین اور احمد داؤد پیئر

سید بابر علی سکول برائے سائنس اور انجینئرنگ، لمز



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The Plastic Brain

CONSEQUENCES OF BLINDNESS

Anum Nawaz

Over time, neurologists have discovered multiple aspects of the brain both in terms of physiology and functionality. While, brain is a highly functional organ, it specialises in ways that suffices our survival.

One of the ways the brain helps us function and adapt in a particular environment is due to its intrinsic property of plasticity. Plasticity is the mechanism of development and learning that helps us adapt in an ecological framework. Simply put, plasticity is about having weak enough connections to yield an influence but strong enough not to yield all at once. It is seen most evidently in blind people however it does not mean

that plasticity is a way in which the brain compensates for a biological or physical disadvantage. It is not an occasional state of nervous system which only appears in case of blind people, but it is a normal ongoing state of the nervous system throughout lifespan. Simply put, it is the result of the brain's adaptation to undergo constant changes in response to modifications in its input afferents and output targets.

Growing literature in experimental research in neuroscience gives evidence and insight to this highly delicate system of brain plasticity. In a study conducted by Leone et al (1995), 2 groups of participants were trained to mental and physical stimulate motor outputs. They were instructed to perform a sequence of finger movements fluently during transcranial magnetic stimulation. It was seen that the mental stimulation of movements activated some of the central neural structures required for the performance of actual movements. Once near perfect level of performance, the subjects were randomized in 2 groups. One group continued daily practice, while the second group stopped the practice. It was seen after a week that in the group who had stopped practicing,

the activity of motor output stimulation significantly dropped compared to the baseline. This experiment suggests that acquisition of necessary motor skills to perform a movement task is correctly associated with reorganisation in the cortical motor outputs to the muscles involved in the task. It also suggests that changes in the activity across a distributed neural network may be able to establish new patterns of brain activation and sustain function.

Growing experimental evidence in blind people suggests some interesting patterns in brain plasticity. The brain areas commonly associated with the processing of visual information are recruited in a compensatory cross modal manner that accounts for superior nonvisual capabilities. Phelps et al (1981) demonstrated that in early blind subjects, the primary visual cortex is activated while Braille reading task. They were among the first to suggest that occipital cortex is active in blind people. However, Uhl et al (1991) found out that just the passive sweeping of the finger over a homogenous pattern of Braille dots did not result in activation of primary visual cortex.

Hamilton et al (2000) reports the case of a congenitally blind woman who was once a proficient braille reader that had difficult reading Braille after bilateral posterior cerebral artery strokes. This was despite the fact that her somatosensory sensation, peripheral motor and sensory nerve functions were all intact. Even though she was aware of the dots, she could not extract the meaning. While she did well on other tactile tasks such as identifying the roughness of the surface or distinguishing between different coins, she was not able to judge distance between braille dots or read braille. This case suggests that a functioning occipital cortex is needed to carry out the task of braille reading.

While the brain has the ability to use connections in ways that helps us adapt to function properly, it can also establish new connections to serve the purpose of adaptation. It is also seen that in the sooner these connections are built, the better the functioning. This was demonstrated by *Burton et al* (2002) in an experiment in which he instructed subjects to generate a verb in response

to reading a noun cue presented in braille. They found that occipital cortex activation was much more prominent in early than vs in late blind subjects. We have seen through these experiments that the function of the occipital cortex changes from simple processing of visual information to processing information related to another sensory modality.

We have also seen that the brain has the capability of unmasking pre-existing connections and shifts in connectivity to present rapid, early plastic changes which can lead to structural changes. In case of blindness, the nervous system is moulded rapidly by shifts of strength in existing connections. New structural connections re-establish giving rise to new capacities such as the recruitment of occipital cortex. Hence plasticity seems to be an obligatory consequence of all neural activity and environmental pressures.

This process of unmasking existing connections and the establishment of new ones gives rise to unexpected potentialities and capacities to utilize the brain's limited resources.



Morphing Through Time

Roshaan Bukhari

Out of the ashes of gloom and despair, our mammalian ancestors managed to emerge riding the surf of survival, birthing forth an exquisite diversity, precedence of which remains to be seen on other water worlds in orbit around our mighty Sun. In this vast cosmos, we are a curious anomaly.

Stuck in the maze of time, we carry the remains of long-lost ancestors within every growing wrinkle of the skin, colourful tendrils of the iris, within every involuntary reflex and twitch of our muscles and within every cell of the body. From the day we're born, we

begin intimate whispers chat with curiosity. A trait we never asked for – but which keeps a persisting presence in our specie. Natural selection seems to have carefully crafted this appeal. How many times have we enjoyed the beauty of a sunset, or the myriad of



colourful stars at night – bright and dim? Curiosity has a mind of its own. Our ancient forefathers dwelled on their ability to outsmart and outlive predators; a process that has ensured our existence and survival. Driven by this mysterious force within, I wonder how many of them looked up at the night sky and wondered in a language long lost to the fog of epochs, “*are we alone?*”, and “*why are we here?*” – an everlasting itch. Where we’ve heaped functional structures by virtue of our slow crawl through the temple of time, we’ve also gathered the moss of vestigial features, a relic from the past that continues to live in our present.

Some interesting examples include the left recurrent laryngeal nerve, whose path in the body seems inane, and completely non-intuitive. This nerve originates from the brain and innervates the larynx (voice box). Whereas the right recurrent laryngeal nerve takes a more direct path from the brain to the voice box, just rounding the corner near one of the carotid arteries in the neck, the left counterpart first travels all the way down through the neck, into the thorax, winding neatly around the arch of aorta, the largest blood carrying vessel exiting the heart, then making its way back up the thorax, into the neck and finally terminating at its destination, the larynx. In this drawn-out course, it does not seem to innervate anything else, as if the entire round trip around the aorta was just a waste of precious nervous tissue.

So, what is it? Mindless meandering or is there a method to this madness?

It turns out that the answer lies at the tail end of a deeper look into our past. Early life forms were almost entirely water borne. Fish, and other marine life had uncomplicated paths of innervation from the brain to their gills. This network of innervation included the prelude to what are now the recurrent laryngeal nerves, found in all mammals. Through evolution, organisms got larger, the heart moved lower into the thorax and ‘dragged’ one of the nerves

down with it, hooking it around what was to become the arch of aorta. This effect is most pronounced in the giraffe, which on average has a neck that is at least six feet long, and the left recurrent laryngeal nerve travels this entire course, only to innervate the larynx present in the upper part of the neck.

The gift of evolution keeps on giving.

There is an interesting surprise hiding in the wrist of 14% of the population. Lay your arm on a flat surface and try to join your thumb with your pinky finger. Do you see a conspicuous tendon rise above the epithelial landscape, right in the middle of the wrist? If you don’t, then natural selection has put you in a rare 14% of the population, that is devoid of a muscle in the wrist called the palmaris longus. The palmaris longus is undergoing what is known as non-adaptive, stochastic evolution. This means that the muscle is slowly vanishing from our bodies and is no longer in demand as primates transition away from an arboreal lifestyle. If you must know, it is still present in certain species of the orangutan!

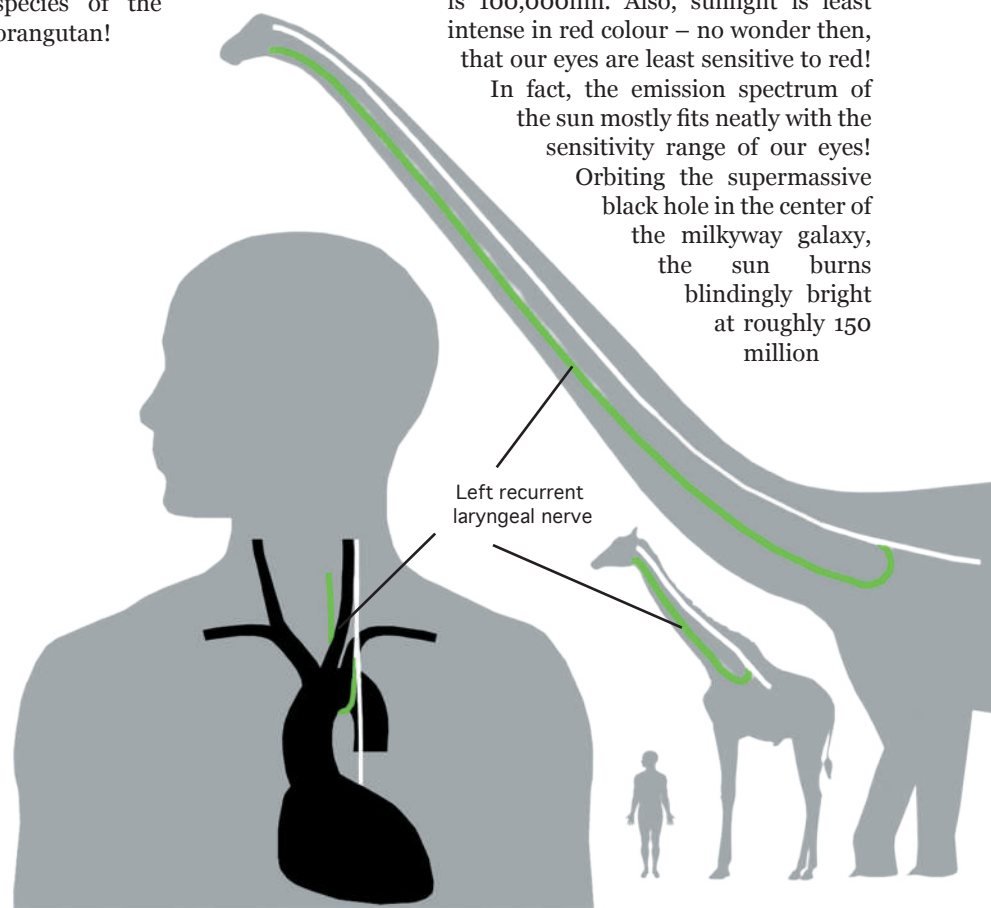
The nature of adaptation is plastic.

Trillions of cells, each one a castle of sublimity, encapsulated with a delicate boundary, all functioning in a peaceful coexistence, never tired nor bored. What is the extent of this plasticity? Well, it literally goes all the way to the sun!

Our eyes are two 5-millimeter-wide light buckets, programmed to create tiny electrical impulses from the gentle absorption of photons by a thin layer of retinal tissue. Our primeval ancestors had spent most of their time under natural lighting conditions i.e., the sun as their only source of bright light. Over time, their retina evolved to become most sensitive to wavelengths of light given off most abundantly and generously by the sun. It is understandable how this could have been most advantageous for survival. With advances in physics, we understand that stars like the sun emit blackbody radiation that peaks in the wavelength of about 500 nanometers (Wien’s law), which is fancy for the colour green. Thus the human eye is most sensitive to green colour. For reference, the thickness of a typical page is 100,000nm. Also, sunlight is least intense in red colour – no wonder then, that our eyes are least sensitive to red!

In fact, the emission spectrum of the sun mostly fits neatly with the sensitivity range of our eyes!

Orbiting the supermassive black hole in the center of the milkyway galaxy, the sun burns blindingly bright at roughly 150 million



kilometers from us, yet its impact on our tiny but magnificent photoreceptors is astounding. They both need to take the curtain call on this one! Lets zoom out now.

Your origins, and of every single human being who is yet to live, or has lived, and every single life form that may be thriving on a second Earth millions of light years away, or of a fellow learner in another galaxy struggling for answers to deep questions on a land with many suns – they're all connected through a common origin. Cast from a morsel of unimaginable inferno some three minutes

after the big bang, your atoms have waited for over thirteen thousand million years to assemble on to a watery world, the flora and fauna of which has fed the entire lineage of your ancestors. Some have assembled into other strangely curious, but awesome creatures, others are placed high in the sky far from Earth, some as stars and galaxies, others still waiting for their turn in the depths of colourful nebulae, and protoplanetary disks. To make matters worse for the hubris, your current assemblage comes with a frail and unconvincing warrantee. Eons after we pass away, our atoms and molecules will scatter back into the Earth, enriching the assembly line of new organisms, waiting for physical processes to announce their birth, ready for another round of the same.

Are we really a curious anomaly? Just four parts in a hundred of our genome separates

us from our closest relatives on Earth, the chimpanzees.

Yet, it is us that can create symphonies, art, technical masterpieces like the James Webb Space Telescope, invent mathematics and contemplate our place in the universe. Is 4% too much to ask for? The same differential might also be responsible for the smartest chimpanzees doing mundane tasks as their best demonstration of cognition or intelligence (as we define it, of course). Granted there is probably an inherent flaw in the way we portray our intelligence as a benchmark and project it on other organisms that do not stand a chance to fulfil the criteria of qualifying. However, think of the possibility of

extending this small fraction of a difference in genome from us to an extraterrestrial life form; that it is 4% ahead of us in all that we do. Ask yourself again: is 4% too much to ask for?

If not, then how far ahead would they be from us, just like we think we are from the chimps. Would they be interested in visiting us, talking to us? Would they be interested in our dreams, our stories, and our ambitions?

So far, we are on our own in an endless universe.

Plodding on the regolith of Earth, we've gathered tools to access knowledge and wisdom and in its wake we've taken some good decisions, and many bad ones. As we contemplate our citizenship of earth and our future, our evolutionary relics remind us of a fragile relationship between life and death, physiology and teratology; the planet and deep space, the universe and us. Let us remind

ourselves of who we are – a curious anomaly. The stuff that makes us up can be traced back to unimaginably hot cores of giant stars in space. The universe is both our cradle and grave. So, cherish, and celebrate the brief time you have on Earth while you continue to contemplate, articulate, explore, and morph through time.

Today and forever.



Home?

Billions of earth-like planets must exist out there. Will they also be home to creatures like us?



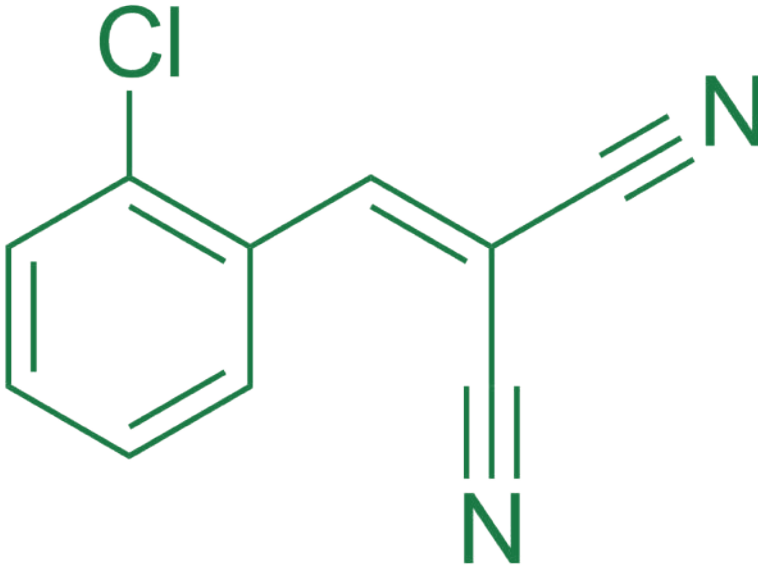
Curious ancestors?

The earliest hand paintings were created roughly 60,000 years ago. Our ancestors seemed curious enough to devise ways of generating art.



1,000,000 A.D.?

How will the forces of nature shape us and our sense of curiosity, a million years from now?



آنسوگیس کے صحت پر دیرپا اثرات

آنسوگیس کے صحت پر دیرپا اثرات فی الحال نامعلوم ہیں۔ تاہم فلسطین میں ہونے والی ایک تحقیق کے مطابق ان مرکبات سے سانس لینے میں دشواری اور غارش جیسے امراض لاحق ہو سکتے ہیں۔ 2021ء میں مینیسوٹا یونیورسٹی کی تحقیق کے مطابق آنسوگیس کے صحت اور ماحول پر طویل المیعادی اثرات کو بہت کم کھوجا گیا ہے۔ اس طرح کے کیمیائی مرکبات پر زیادہ تر تحقیق 60 اور 70 کی دہائیوں میں کی گئی جس میں تجدید کی اشد ضرورت ہے۔ جدید تحقیق کے مطابق آنسوگیس دے اور بلند فشار خون کے مریضوں کے لیے جان لیوا ہونے کے ساتھ، خواتین میں ماہواری میں بے قاعدگی اور دائمی اور نفسیاتی مسائل کا باعث بن سکتی ہے۔

آنسوگیس سے بچاؤ کیسے ممکن ہے؟

1962ء میں جریدے "سائنس" میں شائع ہونے والے ایک مضمون کے مطابق آنکھوں کو بورک ایسڈ کے محلول سے دھو کر ان جلن کو کم کیا جاسکتا ہے۔ بہترین حکمت عملی اس جگہ سے دور کھلی ہوئی جاننا اور آنکھوں کو پانی سے دھونا ہے۔ ایک پرندے کی طرح اپنے بازو پھر پھڑکانا بھی مفید ہے کہ اس عمل سے طیران پذیر مرکبات سے چھٹکارا پانے میں آسانی ہوتی ہے۔ پانی ہائیڈرولائسز کے عمل سے سی ایس کی توڑ پھوڑ کرتا ہے جس کو بلندی۔ ایچ پر تیز تر کیا جاسکتا ہے۔ لہذا پی۔ ایچ 8 والا پانی مفید ہو سکتا ہے۔ مزید براں پانی میں کھانے کا سوڈا بھی شامل کیا جاسکتا ہے۔ او۔ سی یا مریحوں کی پھوار کے لیے دودھ یا لسی مفید ہو سکتی ہے۔

تحریر:

محمد ظہیر، اسٹنٹ پروفیسر شعبہ کیمیا، ویکیمیائی انجینئرنگ

آنسو گیس کیسے منتشر کی جاتی ہے؟

سی۔ ایس کو ایک نخل میں چار کول اور پوٹاشیم نائٹریٹ کے آمیزے کے ساتھ بند کر کے جلایا جاتا ہے۔ چار کول ایک ایندھن کے طور پر کام کرتا ہے جبکہ پوٹاشیم نائٹریٹ کا کام جلنے کے لیے درکار آکسیجن مہیا کرنا ہے۔ اس تعامل کو جاری رکھنے کے لیے فاضل ایندھن اور تنکیدی عامل کی ضرورت ہوتی ہے جو بالترتیب چینی اور پوٹاشیم کلورائیڈ پورا کرتے ہیں۔ ایندھن کے جلنے سے بننے والا دھواں اور پوٹاشیم کلورائیڈ، سفوف کو باریک ذرات کے ایک بادل کے طور پر منتشر کرتے ہیں۔ اس کے علاوہ سفوف کا محلول بنا کر اس کی باریک پھوار بھی بنائی جاسکتی ہے۔

آنسو گیس کی تاریخ

آنسو گیس کا پہلا باقاعدہ استعمال پہلی جنگ عظیم میں حملہ آوروں کے جتھوں کو منتشر کرنے اور سپاہیوں کو بدحواس اور ناکارہ کرنے کے لیے کیا گیا۔ جنگ کے خاتمے پر آنسو گیس بنانے والے کمپنیوں نے امریکی پولیس کو نئے گاہک کے طور پر پھانس لیا۔ جنگ کے بعد ہزاروں سپاہی جب اپنے وطنوں کو لوٹے تو انہیں ملازمت حاصل کرنے میں شدید دشواری کا سامنا کرنا پڑا۔ معاشی مسائل کی وجہ سے مزدور اضطراب کا شکار ہوئے جو بالآخر سیاہ فام اور سفید فام امریکیوں کے بیچ جھڑپوں میں تبدیل ہو گیا۔ جس کے لیے وفاقی فوج کو طلب کرنا پڑی۔ قانون نافذ کرنے والے اداروں کو ہجوم کو قابو کرنے والے ایک ہتھیار کی ضرورت تھی جس کے لیے آنسو گیس ایک بہترین انتخاب تھا۔ یاد رہے کہ آنسو گیس کا جتھوں میں ایک کیمیائی ہتھیار کے طور پر استعمال جینیوا کنونشن میں ممنوع قرار دیا گیا تھا۔

©CNS photo, Paul Jeffrey



آنسو گیس کی سائنس

آنسو گیس، آزادی مارچ اور سائنس

تحریک انصاف کے حال ہی میں ہونے والے آزادی مارچ کے شرکاء کو منتشر کرنے کے لیے قانون نافذ کرنے والے اداروں نے آنسو گیس کا بے دریغ استعمال کیا۔ یہ گیس آنکھوں، جلد، منہ اور پھیپھڑوں میں شدید درد اور جلن کا باعث بنتی ہے۔ آنکھوں اور ناک سے پانی بہنا شروع ہوتا ہے اور سانس لینے میں دقت ہوتی ہے۔ چھینکوں اور متلی سے شروع ہونے والا سلسلہ قے تک بھی جاسکتا ہے۔ گیس کے اثرات تقریباً 30 منٹ تک برقرار رہتے ہیں۔ آئیے اس گیس کے بارے میں مزید جاننے کی کوشش کرتے ہیں۔

آنسو گیس کیا ہے؟

دیکھیں بات یہ ہے کہ موجودہ دور میں استعمال ہونے والی آنسو گیس درحقیقت کوئی گیس نہیں بلکہ ایک سفوف یا محلول ہے۔ آنسو گیس جیسی خصوصیات کے حامل کئی مرکبات اپنا وجود رکھتے ہیں تاہم زیادہ استعمال ہونے والا کلورین کا ایک مرکب سی۔ایس (2-کلورو بنیز لمانو نائٹرائیل) ہے جسے ایک امریکی کیمیا دان بن کورسن نے 1928ء میں تیار کیا۔ اسی گروہ میں شامل دیگر آنسو آور مرکبات میں سی۔آر (ڈائی بنیز آکساز پیپین) اور سی۔این (کلورو ایسیٹو فینون : ویت نام جنگ میں استعمال ہوئی) شامل ہیں جو سی۔ایس کے مقابلے میں زیادہ زود اثر ہیں۔

آنسو گیس کے طور پر استعمال ہونے والے مرکبات کا دوسرا گروہ مرچوں کے پودے سے حاصل ہونے والے مرکب کیپا نسنین سے ماخوذ ہے۔ مثال کے طور پر او۔سی (اولیم کیپیٹیم) کیپا نسنین کا ایک مرتکز محلول ہے جسے ایک پھوار (سپرے) کے طور پر منتشر کیا جاتا ہے۔

آنسو گیس کیسے کام کرتی ہے؟

منہ، ناک، پلکوں اور پھیپھڑوں کے اندر ایک نڈار جھلی (میو سکس ممبرین) موجود ہوتی ہے جس کا بنیادی کام ذرات (دھول) اور بیماریاں پھیلانے والے جانداروں سے حفاظت ہے۔ یہ آنسو گیس کے سالموں کو بھی ایک بیرونی حملہ آور تصور کران کے خاتمے کی کوشش کرتی ہے۔ او۔سی اور دیگر مرکبات میو سکس جھلی میں جذب ہونے کے بعد عصبی خلیوں (نیوراز) تک اپنا راستہ بناتے ہیں۔ کیپا نسنین ان خلیوں میں ایک مثبت چینل ٹی۔آر۔پی۔وی 1 کو متحرک کرتا ہے۔ جس کے نتیجے میں دماغ کو درد کے پیغامات وصول ہوتے ہیں۔ سی۔ایس اور دیگر مرکبات ٹی آر پی اے 1 چینل کو متحرک کر کے یہی کام سرانجام دیتے ہیں۔



AUGMENTED REALITY

BLURRING THE BOUNDARY
BETWEEN IDEAS AND
REALITY

Yawar Abbas Bokharee

Science fiction movies set in the future tend to pique our interest and curiosity for a utopia.



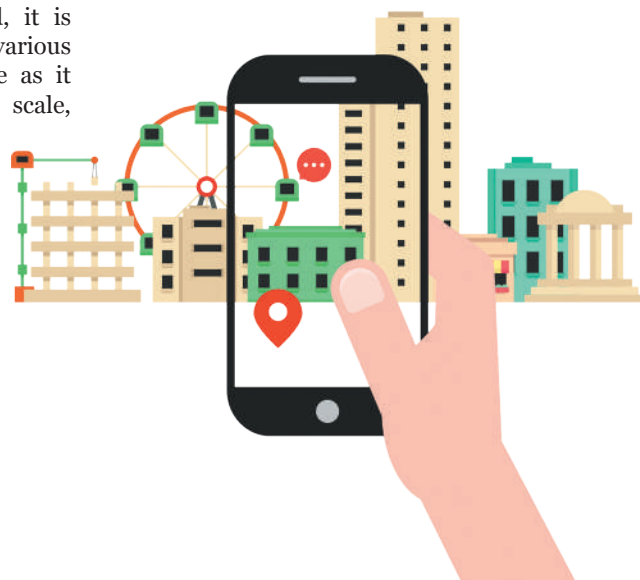
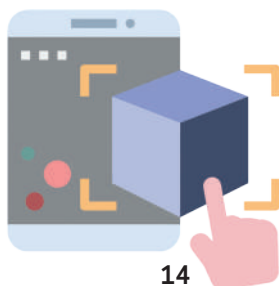
Here are a few examples

- Navigation system to identify routes and traffic situations.
- Space sports analysts will find help in analysing players with marked movements and highlight stats.
- Aircraft pilots and mountaineers will use it to determine altitude and distance.
- Surgeons and architects will use 3D models to discuss their plans with patients and clients.
- Historical places will be marked with historical facts.

They offer glimpses into technologies born from both wishful and critical thinking, many of which have seen the light of day; be it flat screen tablets from the classic 2001: A Space Odyssey, or the self-driving cars in Jurassic Park.

Moving forward many decades from when its early variants were first televised in hit TV shows like Star Trek and Star Wars, augmented reality (AR), originally described by Thomas Caudell, is one of those technologies which is now a 'reality'. Originally, Thomas was trying to help the workers at the aircraft giant Boeing, to visualise complicated aircraft systems and their interconnectivity. This technology spilled over to many other institutions and organisations that used it to achieve their desired engineering, artistic or commercial targets.

AR is basically a layer of digitally crafted elements (graphics, 3D objects, effects, etc.) grafted on to the visuals reality recorded through a camera sensor, which usually has a form factor like popular consumer products like smartphones and smart glasses. Many companies have launched hardware that relies on the delivery of an authentic AR experience, including tech giants like Google, Apple, and Samsung. This is already helping billions of people across the globe in translating languages and GPS mapping. Moving forward, it is predicted that AR's impact on various consumer markets will be huge as it poised to help the consumer scale, recognise, identify, and compare products in an instant!



wind chill FACTOR

Yawar Abbas Bokharee

Many mountaineers suffer from severe injuries in pursuit of a summit during a winter ascent.

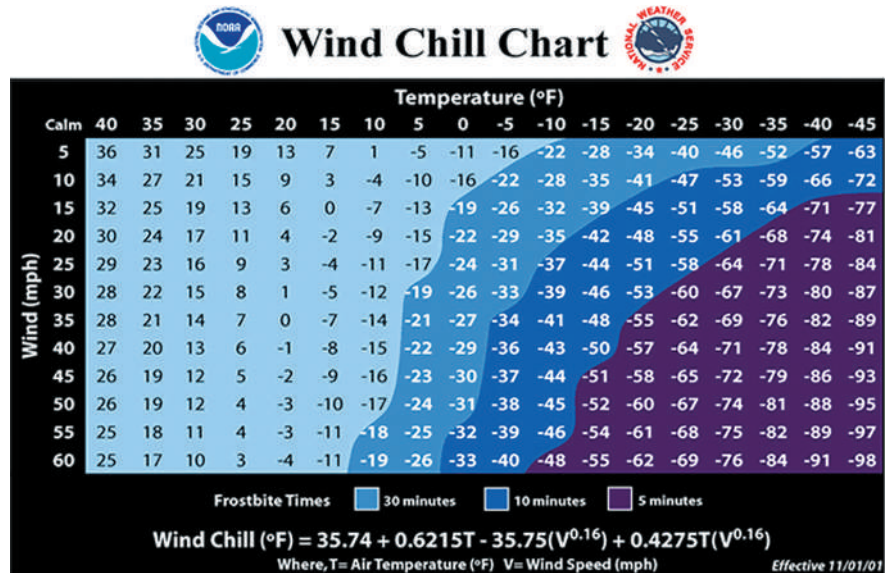
These include frostbites and sunburns, and critical situations in the death zone. The most life-threatening condition is a severe blow of a cold wind on the summit, which transforms any adventure into an emergency for the avid explorer. This deadly element is called the wind chill factor.

Weather reports are frequently framed like, 'Today is 30°C, and it feels like 38°C'. The 'feels like' is credited to a combination of factors, including wind. Air is able to penetrate into the human insulation and lowers the body temperature. The human insulation protects and warms the body in no or slight wind. This factor becomes a fatal trap for the mountaineers on the high-altitude peaks as the wind speed is more than 140 km/h!.

One of the implications of the wind chill is hypothermia. In this condition, the human body becomes weak and uncoordinated, and the brain starts hallucinating. This happens when the body temperature is lower than 35°C for a consistently long period of time. This usually occurs during a high altitude climbing, where both oxygen and the temperature tend to be lower. The wind chill accelerates these conditions and makes hiking more challenging.

The National Weather Service (USA) has developed a Wind Chill index that allows us to calculate the safety levels of uncertain weather conditions. This was

developed through a simple Bluestein formula to find out the risk factor of frostbite. The weather agencies still use it in their weather reports.



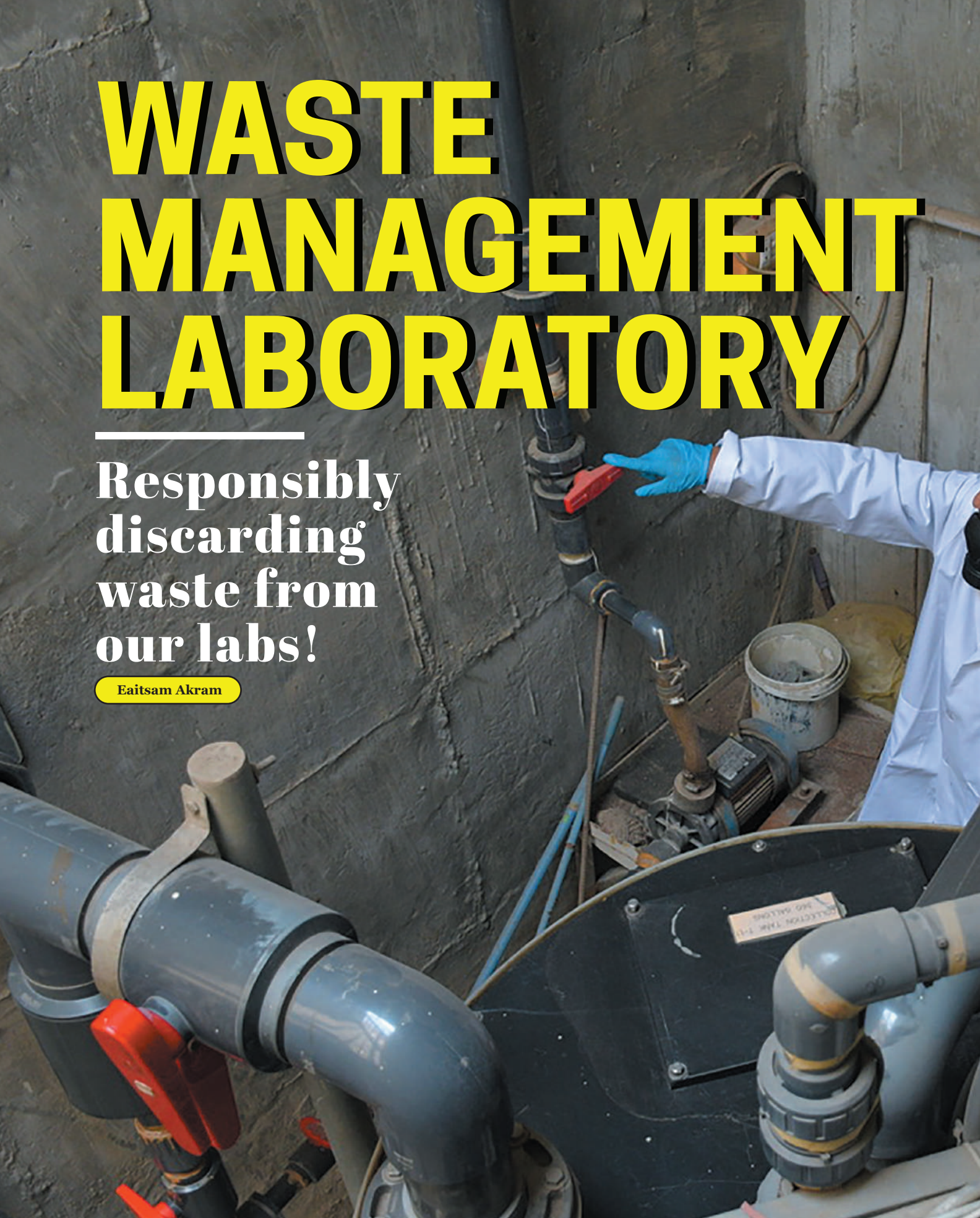
کیا آپ جانتے ہیں؟

ایک بادل کا وزن تقریباً ایک ملین پاؤنڈ ہو سکتا ہے۔
ہمچن میں بادلوں کی سیر اور بادلوں پہ سفر ہمارے خواب ہوا کرتے
تھے، آج جدید سائنس کی بدولت یہ معلوم ہوا ہے کہ اوسط
کمپل (cumulus) بادل کا وزن ایک ملین پاؤنڈ تک ہو سکتا ہے۔
یہ دنیا کے سب سے بڑے ہوائی جہاز جتنا بھاری ہے جب وہ پوری
طرح ساز و سامان اور مسافروں سے بھرا ہوا ہو۔

WASTE MANAGEMENT LABORATORY

Responsibly
discarding
waste from
our labs!

Eaitsam Akram



Waste management is the collection, transport, processing or disposal of waste materials, usually ones produced by human activity, in an effort to reduce their effect on human health or local aesthetics or amenity.

In the Syed Babar Ali School of Science and Engineering, the Safety and Engineering Cell manages hazardous waste in compliance with standard waste management procedures, followed all over the world. Hazardous waste is mostly generated from science labs across the School in the form of hazardous liquids (e.g., acid, base, oxidizers, flammables, biohazardous liquids) and hazardous solids (solid chemicals, infectious syringes, containers, tubes etc.).

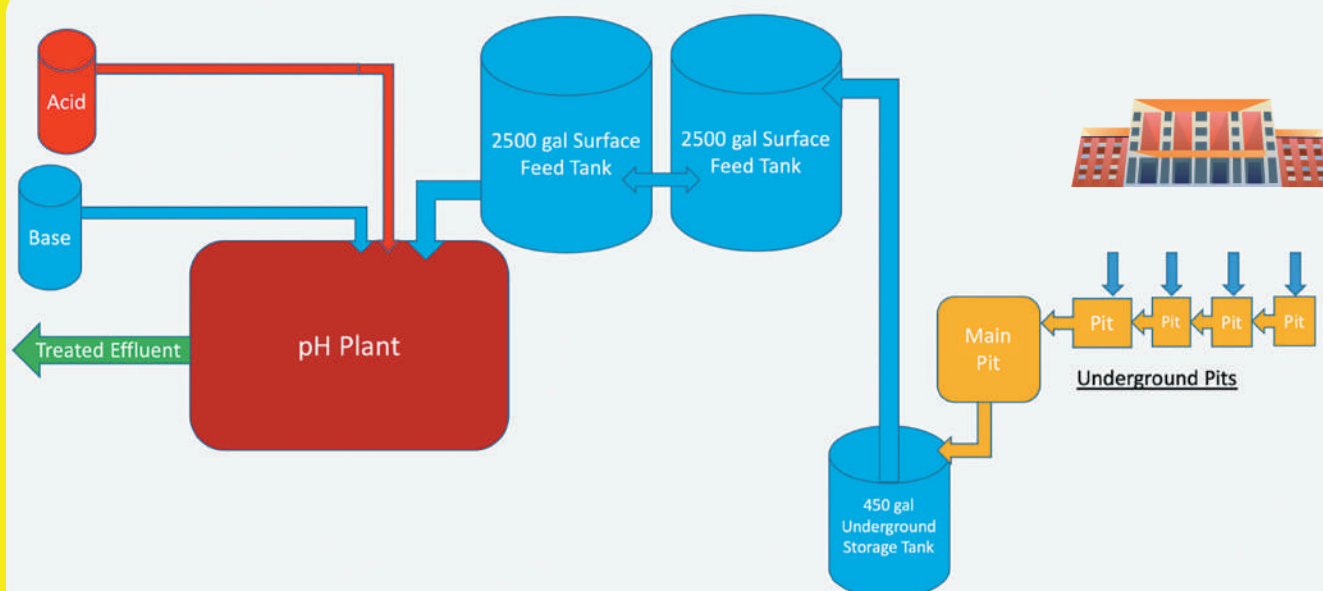
Each lab contains designated hazardous containers. These drums are colour coded for chemical and biohazardous waste disposal. Yellow drums are designated for chemical waste and red containers are designated for biohazardous waste. Lab occupants dispose all the hazardous waste in the designated hazardous waste drums and once the waste container reaches 80% of its capacity, it is then transported to waste management lab. Sinks installed in these labs and drains are connected to waste management lab to ensure that all hazardous waste goes for treatment.

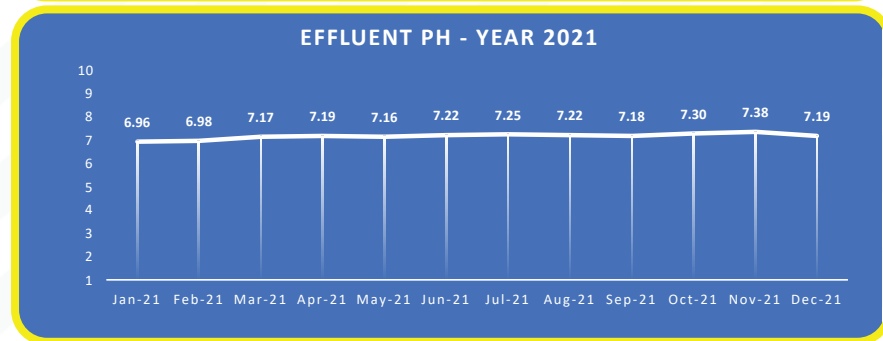
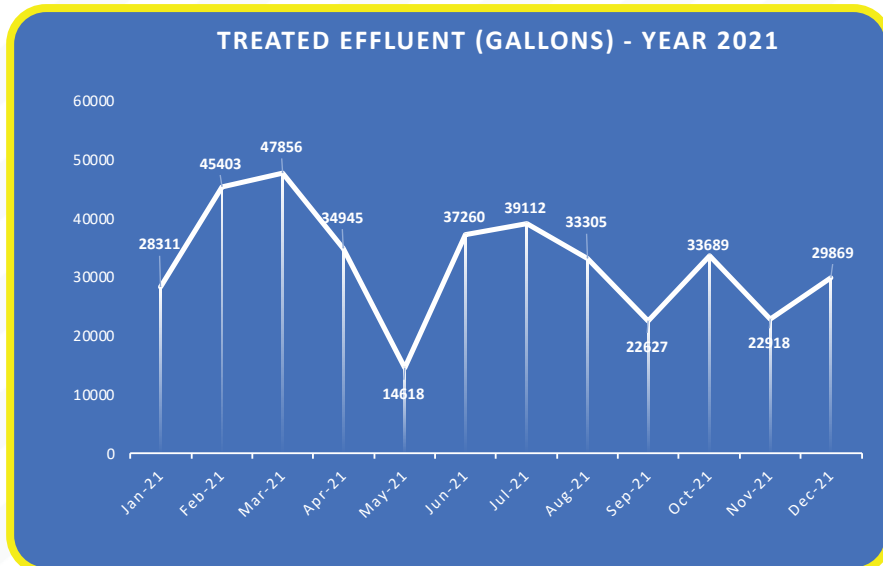
The team that makes this possible comprises of Omer Qureshi (Safety Supervisor) and Makhdoom Hussain (Safety Technician). They are supervised by Eaitsam Akram, who heads the Safety and Engineering Cell. They are responsible for treatment and safe disposal of hazardous waste. Daily readings of pH neutralisation unit and storage drums are documented digitally, and a record of all prior readings is kept for trend analysis.

Working of the pH neutralisation unit includes the following steps:

1. SSE lab effluents goes to an underground pit.
2. The effluent is then transferred to underground storage tank.
3. Effluent from underground tank is transferred to feed tanks depending on the water level in the underground tanks.
4. The water is then transferred to 2-stage mixer where water pH is maintained within the range 6-9 using acid and base dosage.
5. The waste is then drained after controlling the pH.

The objective of waste management at SBASSE is to reduce the generation of waste (both solid and liquid), and to ensure that all the generated waste is treated per best practices and the processes are compliant with the best global waste management standards.





A PIONEERING EFFORT IN ACADEMIC SAFETY



An overview on occupational health and safety measures taken at SBASSE to ensure the well-being of the community.

The health, safety, and wellbeing of our faculty, staff, students, and visitors are vitally important to us. Furthermore, we understand that health and safety has a vital role in supporting and enabling world-leading teaching and research. To achieve this, the Syed Babar Ali School of Science and Engineering will ensure effective management of our risk by setting, implementing, and reviewing a health and safety management system, through continual improvement and by allocating the resources necessary

to attain these. We will also define clear management systems and ensure the involvement of people at all levels when considering the actions necessary to meet this mark.

OHS committee is set up to formulate health and safety policies, procedures, promote awareness, and implement risk management systems to provide healthy working conditions and to prevent injury and ill-health.

Safety reporting system is available for immediate reporting of safety observations (unsafe act, unsafe condition or good practice) and incidents.

Heating, ventilation, and air-conditioning (HVAC) system are in place to help maintain good indoor air quality through adequate ventilation with filtration and provide thermal comfort.

The management of waste produced

during school activities is carried out appropriately and in such a way as to deliver legal compliance and to avoid harm to health and the environment.

All health and safety procedures, guidelines, and related work is documented and everyone should have the access to safety document directory and updates.





SVED BABAR ALI SCHOOL OF SCIENCE & ENGINEERING

SAFETY HANDBOOK

minimum SAFETY guidelines

Breathing a new Future into our Past



This unique combination of archaic knowledge and cutting-edge technology has produced a project that has won THE Awards Asia 2022 for Excellence and Innovation in the Arts.

Through the melding of history with technology, a team of scientists and researchers at LUMS is bringing our heritage to life through digitisation. The Sikh Virsa website project is co-led by Dr. Murtaza Taj from the Department of Computer Science and Dr. Nadhra Shahbaz Khan, who is an Associate Professor of art history at the Mushtaq Ahmad Gurmani School of Humanities and Social Sciences, LUMS.

Dr. Taj's expertise brings in computer vision and Machine Learning to the challenge of recording fine details of artefacts from a bygone era, whereas Dr. Khan's grip on art history, particularly Sikh art and architecture helps narrow down the search for the most significant pieces of history and their value to contemporary culture. Together, they are helping bring to life artefacts from Pakistan's Sikh period, in the process creating new opportunities for collaboration beyond the university. The experts would also like to acknowledge the role of their research assistants Ayesha Ali and Amjad Mughal, who offered a complimenting set of technical skills as well as creative writing skills

Dr. Taj exploring panoramas and 3D models of recorded artefacts.

respectively, that fit very well with the kind of work needed to make the project move on smoothly.

Out of the many challenges, working through the peak of the covid pandemic required great perseverance from the team. Recalling this challenge, Dr. Nadhra stated "It brought in a new sense of significance to the project, as we realized how restricted we were in our movements and how important it was to use a digital platform to reach out to people."

Dr. Taj while recalling the thoroughness of the digitising exercise said, "We tried



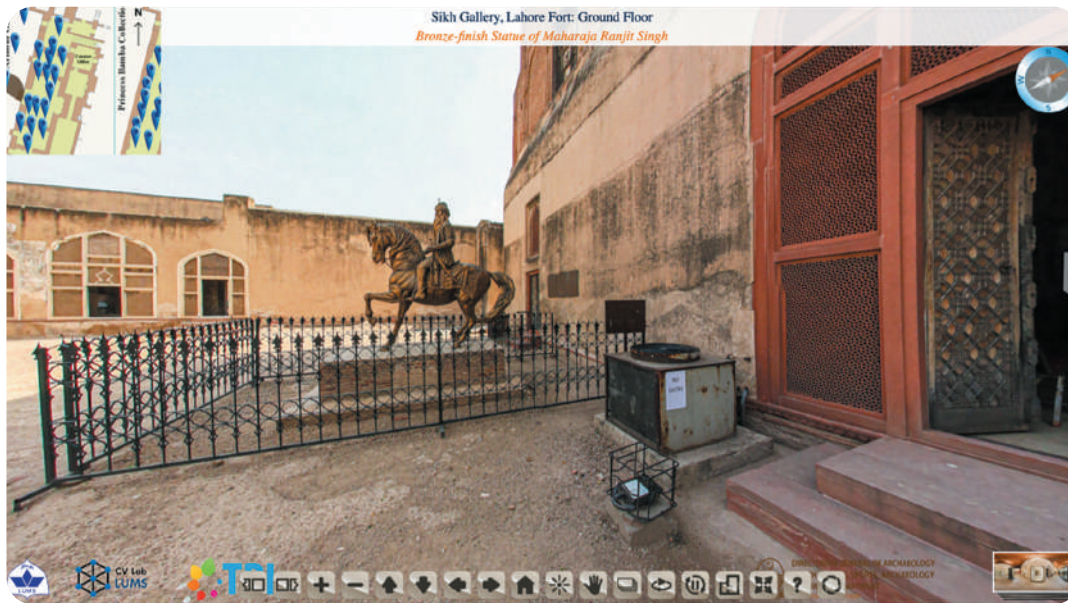
Dr. Nadhra browsing her book titled
The Secular Sikh Maharaja and his Muslim Wife.

to measure every millimeter of the building through laser scanners, panoramic tours and extensive photography [of every single object that needed to be recorded], so that they could be presented in a virtual world.” He also acknowledged the cross-disciplinary manifestation of working at LUMS.

“In this particular case, the coordination between faculty and administration between different schools was amazing!”, he said.

Materials from the iconic Lahore Fort’s Sikh Gallery were given a visual online showcase in Sikh Virsa Pakistan, the first website of its kind in the region, which narrates a journey through Sikh culture and history.

The project aims to make culture more accessible and relevant, bringing the arts to new audiences. The project has also led to the creation of a new undergraduate history course (HIST-2121: Digital Preservation and Historical Documentation) that has engaged students in the humanities, social sciences and pure sciences in learning to use computer software to complement traditional research and learning methods. It has also inspired other museums to develop similar projects.



One of the 360 panoramas from the project, showing part of the Lahore Fort.

Dr. Murtaza has been collaborating with Dr. Nadhra since 2015 over various forms of the idea to preserve and digitise our heritage.

The team would like to acknowledge the Department of Archology with utmost gratitude and sincerity, for their cooperation and support throughout the exercise of recording artefacts.

Another spin-off is in a collaboration where 150 LUMS students will spend a semester with as many students from the University of Baltistan in Pakistan's Himalayan north in July 2022. The intervention aims to preserve cultural artefacts that have been discovered from prior Greek, Buddhist, and Christian civilizations, exposing students to critical preservation skills needed in the country.

Describing the initiative as “impactful and collaborative”, the judges said: “Through internal, multidisciplinary collaboration between the computer science and history departments, a new project has emerged – a new but not necessarily exclusive way of looking at and reading history.”



Plaster Cast Bust of Duleep Singh.



Nadhra Shahbaz Khan is Associate Professor of art history at the Lahore University of Management Sciences. A specialist in the history of art and architecture of the Punjab from the sixteenth to the early twentieth century, her research covers the visual and material culture of this region during the Mughal, Sikh, and colonial periods.



Murtaza Taj is an Assistant Professor at the Lahore University of Management Sciences. His research interest lies in the area of Computer Vision, Graphics and Image Processing. In particular, he is interested in detection and tracking of object in 2D and 3D scenes and in automatic generation of 3D models from raw point cloud data. At LUMS he is a director of Computer Vision and Graphics Lab and the director of Technology for People Initiative.

To see more heritage conservation projects by the team, visit: heritage360.pk

PROMISING OUR NEW LAB

**The Muhammad
Zaka-ur-Rehman
Microbial Genomic
& Multidrug Resistance
Laboratory**

The Syed Babar Ali School of Science and Engineering's garland of laboratories welcomes its newest member; The Muhammad Zaka-ur-Rehman Microbial Genomic and Multidrug Resistance Laboratory!

We would like to specifically mention the following and thank them for their generous donations:

Almas Retail Pvt Ltd, Ahmad Zaka Ur Rehman, Almas Zaka Ur Rehman, Muhammad Saad Munawar Khan, Hamid Mohammed Zaka, Zaka Healthcare, Khadija Zaka Khan/Bushra M. Zaka, Quality Impex, Bushra M. Zaka, Amina Zaka, Schazoo Zaka (Pvt) Ltd, Zeba Ahmed Shuja, Aasia Saail Khan and The Schazoo Pharmaceutical Lab.

It is indeed a great news for the School, but an even better, more exciting one for the entire community of Pakistani scientists and our society at large. The Muhammad Zaka-ur-Rehman Microbial Genomic and Multidrug Resistance Laboratory is poised to be our gateway to a healthier and happier Pakistan!

Through Mentorship & Hard Work

Ahmed Salman & Muhammad Ibrahim

***LUMS is a Shangri La
for interdisciplinary
work.***

It offers the right mixture needed to create memorable experiences through the cross-pollination of different schools, courses, and faculty; a win-win situation for passionate learners.

Two students of Dr. Zahra Lakdawala, who is a faculty member at the Department of Mathematics at SBASSE, from the Quantitative Finance, FINN422, (sometimes referred to as QuantFinn in this story) course have been accepted to MIT, Oxford, and McGill. They are Ahmed Salman and Muhammad Ibrahim who hail from the Suleman Dawood School of Business (SDSB) and took this course from Dr. Zahra during the Spring 2021 semester.

“Both of them are SDSB students. Muhammad Ibrahim is also graduating as a CS minor. MIT is intense with its admission process and its round of interviews. This is where Ibrahim said the course and its content, particularly the modeling and applying it using python packages for solving really helped!”, said Dr. Zahra, recalling the work of one of her students involved in this story.



Ahmed Salman, while commenting on the course said "The course I took with Dr. Zahra was one of the most rigorous experiences of my degree. Besides managing an A+ grade, I saw myself intellectually challenged at every step of the way. With the intensive assignments and especially the final project, I used the reference of over 5 textbooks to get through them. Besides coursework, it also piqued my general interest in the subject, as I read books on Chaos Theory and Jim Simons, both topics that I discussed in her office hours." Wrapping up his thoughts, he said "I can confidently say that this course gave me a solid grounding in quant-finance concepts and will surely complement my higher studies."

Muhammad Ibrahim, who got admission offers from MIT, Oxford and McGill said, "Applying to MIT and getting an admission wouldn't have been possible without taking QuantFinn from Dr. Zahra, and without her recommendation for admissions. I am extremely grateful for the help!"

Let's take a closer look at the final year project of Ahmed Salman and Muhammad Ibrahim, which garnered the attention of Dr. Zahra and her colleagues, particularly the detail of work displayed by the two brilliant students.

First, the students had to construct a portfolio that maximizes shareholder returns. "We started with the stocks in the DJIA index as a well-diversified portfolio. We evaluated four approaches of weighing these stocks in our ideal portfolio." The first one prioritised stock with the highest eigenvalues based on their principal component analysis. Because the largest vectors explain most of the stock variation, the hypothesis here was that this portfolio would match the market index while reducing risk.

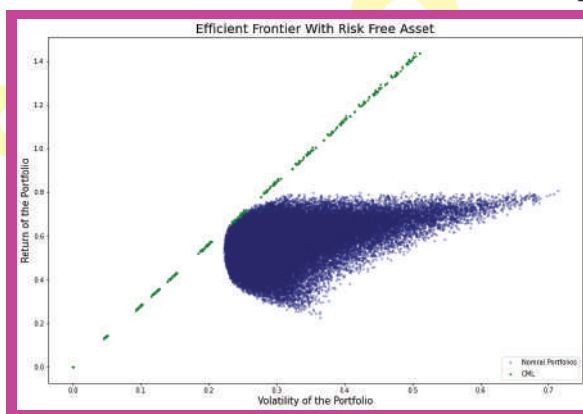
Sure enough, the portfolio seemed to beat the market index while also exhibiting lower volatility.

They also compared this with weights

assigned to stocks based on allowing short sales to minimise variance.

The two portfolios were also judged in performance by looking at their performance over the historical time series period, by dividing it into an in sample and an out sample (which consisted of the last 60 days). Clearly, the portfolio with the maximum eigenvalue (a special set of scalars associated with a linear system of equations) performed better but was also more volatile.

The students then compared these approaches with another portfolio based on maximizing Sharpe ratio weights in the chart below:



The second portfolio generated the highest returns at 9.4% while the portfolio with the maximum Sharpe ratio we computed from the efficient frontier, giving a return of 8.6%. However, the team conclude that the best strategy was to follow the weights of the maximum Sharpe ratio portfolio, as they will beat the market over the long run and give a good risk-adjusted return.

Regarding Option Pricing, the team said "In the second question, we approximated the value of a call option on Apple (AAPL) with the numerical solutions to the Black Scholes model. We used three approximation methods: binomial, Monte Carlo and finite differences. Our biggest takeaway here was the importance of being granular enough in using these approximations, such that they divide the target time period into smaller frames or

'timesteps' as call them – for them to accurately price options. For the binomial approximation, we found that it accurately matched the Black-Scholes model but only for smaller timesteps."

Next, the Monte Carlo method modelled underlying prices using geometric Brownian motion. Although for smaller simulations, there are significant differences between the different models, they found that for larger simulations, all schemes converge to the Black-Scholes pricing.

Referring to the most challenging bit, "the finite difference scheme was the most challenging for us." Here, they compared two schemes: explicit and implicit. While the explicit scheme calculates the state of a given system at a different time from the current time, the implicit scheme a solution by solving an equation that includes both the current and later states of the given system. They found that here too the explicit scheme came with a Neumann condition, which required more granular timesteps for it to generate a useful output, as shown below:

Reflections by Ahmed Salman

Earlier, I had taken courses in finance, CS and some in mathematics, but didn't feel like these subjects could be integrated. But FINN422 was an incredible experience because it combined the three subjects together into a holistic experience for us. It forced us to reconcile the financial concepts, mathematical equations, and programming tools we already knew to build a coherent picture in our minds. I still remember being overwhelmed by the initial assignments in this course, fumbling with endless equations and coding challenges, but looking back, I'd do it all again. While it was a very rigorous course, I came out of it with much more than just a good grade. It gave me the confidence to adapt to unfamiliar subjects and really get comfortable in my own skin as I navigate them!



شیشے کی بوتل

کانٹا

سٹیل اسٹرا

چمچ

معیاری پیمانہ کاکپ



دلاتا ہے۔ اپنے ہر عمل اور فیصلہ سے پہلے میں zero waste lifestyle کے چار R اسی ترتیب کے ساتھ ذہن میں دہراتی ہوں اور کوئی بھی فیصلہ کرنے سے پہلے فکر کرتی ہوں :

Refuse => Reduce => Reuse => Recycle

چنانچہ اُن تمام مصنوعات سے انکار کریں جو ماحول دوست نہیں۔ متبادل ماحول دوست مصنوعات تلاش کریں، جن کے متبادل میسر نہ ہوں اُن کا استعمال گھٹانا شروع کریں۔ کم استعمال، دوبارہ استعمال اور ری سائیکل کو اپنی زندگی کا حصہ بنانا ضروری ہے۔ نامیاتی اشیاء اور مصنوعات کا استعمال نا صرف ماحول دوست ہے بلکہ پائیدار، کم خرچ اور صحت کے لئے بھی مفید ہے۔

اس فلسفے کا ایک اور زاویہ اپنے کچرے کی درجہ بندی کرنا بھی ہے۔ نامیاتی کچرے یا کچن کا آرگینک ویسٹ کمپوسٹ کیا جاتا ہے اور اپنی کھاد سے اپنے گھر کی سبزی بھی اگائی جاتی ہے۔ زیرو ویسٹ کا فلسفہ آپ کو ایک مکمل لائحہ عمل مہیا کرتا ہے اور اس طور طریق سے وہ منفی محرکات جنم نہیں لیتے جو مخالفی رد عمل کی کیفیت کو جنم دیتے ہیں۔ یقیناً مانیے آپ کا ماحول دوست ایک چھوٹا سا عمل بھی "اثر رکھتا ہے۔ پانی کی بوتل، ترک ڈسپوز ایبل، اور پلاسٹک سے انکار سے آج کے ہفتہ کا آغاز کیجئے، اور آہستہ آہستہ روزانہ کی بنیاد پر اپنے "طرز عمل میں تبدیلیاں لیتے آئیے، اور "اثر کی تحریک کا حصہ بنئیے۔

مدیحہ رحمن



ہوں اور آپ بھی کر سکتے ہیں۔ جیسے ہم اپنے دن کا آغاز دانت صاف کرنے سے کرتے ہیں میں نے بھی دانت صاف کرنے کے برش سے کیا، اور پلاسٹک کی بجائے بانس سے بنے برش کو استعمال کرنا شروع کیا، جو کہ ہانچ سے دس سال میں اپنا آپ اس دھرتی کے حوالے کر دیتا ہے اس کے برعکس ایک پلاسٹک کا برش پانچ سو سال سے بھی زائد کے عرصہ میں ڈی کمپوز ہوتا ہے۔ اسی طرح ڈسپوز ایبل اشیاء کی حوصلہ شکنی کے لئے پلاسٹک کی بوتل بار بار خریدنے کی عادت کو ترک کیا اور شیشے کی دوبارہ قابل استعمال بوتل کو اپنا ساتھی بنایا۔ میں روز دفتر آنے سے پہلے اسے پانی سے بھر لاتی ہوں اور جہاں موقع ملے دوبارہ بھر لیتی ہوں۔

اسی طرح ایک معیاری پیمانے کا گلاس یا کپ بھی میرا ساتھی ہے جو میں کسی بھی مشروب مثلاً کافی خریدنے کے لئے استعمال کرتی ہوں، تیسری چیز جو میری روزمرہ کی ساتھی ہے وہ ہے ایک چھوٹی سی تھیلی جس میں میرا اسٹیل کا سٹراء، ایک چمچ اور کانٹا ہے، ان کے ساتھ ساتھ میں ایک سادہ کپڑے سے بنا تھیلہ بھی ساتھ رکھتی ہوں جو خریداری کے لئے پلاسٹک کی تھیلیوں کا متبادل ہے۔ ڈیجیٹل دور میں اگر کچھ ہاتھ سے لکھنا مطلوب ہو تو میں پرانے اخبار سے بنی یہ سکے کی پینسل استعمال کرتی ہوں جس کے سرے پرینج ہیں، جو جب یہ مکمل گھڑ جاتی ہے تو اس کا ہر ازمین میں بُو دینے سے میرے ہاتھ کا لگا ایک پودا نکل آئے گا۔ اگر آپ انٹرنیٹ کی مدد لیں تو آپ کو پاکستان میں ہی ایسے بے شمار کم خرچ بالانشین متبادل وسائل مل جائیں گے۔ اُن سے دوستی کیجئے اور اپنی زندگی کا حصہ بنائیے۔ انھی چند دوستوں اور کچھ اصولوں کے ساتھ رہنے کی وجہ سے میرا اور میرے ماحول کا رشتہ بہت مضبوط ہوتا جا رہا ہے۔

معاملات زندگی میں یہ طرز عمل دیر پا اور خود کفیل بنانے کے لیے کافی بھی ہے اور یہ رونیہ مجھے منفرد اور صاحب فکر ہونے کا احساس

سکے کی پینسل

دراصل یہ رویہ زندگی کے ہر شعبے اور عمل میں اپنایا جاسکتا ہے اور اس کے لیے کوئی خاص عمر، وقت، وسائل یا تجربہ درکار نہیں۔ آپ میری مثال لیجئے۔ میں پچھلے پانچ سال سے اس تحریک اور فلسفہ کا حصہ ہوں، مکمل طور پر نہ سہی مگر جس حد تک ہو سکے اپنا کردار ادا کر رہی

ماحول دوست رہن سہن اور محرکات، جو ہماری مشرقی ثقافت کا بھی حصہ رہے ہیں، اور ہمارے بزرگوں کا طرز زندگی اس بات کا گواہ ہے کہ انہوں نے ہمیشہ فطرت سے اپنا رشتہ استوار رکھا۔ جیسا کہ آج کل دنیا بھر میں فطرت کے تحفظ کے حوالے سے شعور بیدار کرنے کی کوششیں کی جا رہی ہیں اور اس حوالے سے لوگوں کو اس بات پر آمادہ کیا جاتا ہے کہ چیزوں کا استعمال کم سے کم کریں تاکہ صنعتوں سے ہونے والے نقصان کو کم کیا جاسکے۔ minimalism کی تلقین جو ہمیں مذہبی طور پر بھی کی گئی ہے، کو زندگی گزارنے کا شیوا بنایا جائے۔

اسی طرح استعمال شدہ چیزوں کو دوبارہ استعمال کے قابل بنانے کے حوالے سے بھی شعور اجاگر کیا جا رہا ہے جبکہ ہماری مشرقی معاشرت میں یہ تمام عادات ہمیشہ سے پائی جاتی تھیں۔ چیزوں کو دوبارہ استعمال کرنے کے حوالے سے ہماری کئی ایسی عادات تھیں، جنہیں اب نئی نسل تقریباً ترک کر چکی ہے۔

یہ بات درست ہے کہ ماحول پر کسی ایک شخص کا اثر خفیف یا برائے نام ہوتا ہے لیکن اگر ہر شخص اپنے تئیں اپنا طور طریق بدل کر زندگی گزارنی شروع کر دے تو سوچیں اس کا کیا نتیجہ نکلتا ہے؟ میں نے بھی اپنی زندگی گزارنے کے طور طریق کو بدلا اور زیرو ویسٹ لائیف اسٹائل اپنایا۔ روزمرہ کے معاملات اور عادات میں معمولی تبدیلیاں لا کر ماحولیاتی نظام کی بہتری میں اپنا کردار ادا کرنا شروع کیا۔ زیرو ویسٹ زندگی گزارنے کا ایک فلسفہ ہے، جس کے تحت کچر پیدا کرنے کو کم تر بنایا جاتا ہے اور حتمی ہدف تو ظاہر ہے کہ کچرے کا مکمل خاتمہ ہو سکے۔



ہم اثر دوست

انسانوں کی بنائی ہوئی ٹیکنالوجی نے زندگی کے بے شمار معاملات کو آسان تو کر دیا ہے لیکن دوسری جانب ہم دیکھتے ہیں کہ ہمارا طرز زندگی فطرت سے الجھنے کی کوشش کر رہا ہے۔ ہماری عادات نہ صرف اس کرہ ارض کی حدت کو بڑھا رہی ہیں بلکہ ہمارے ماحولیاتی نظام کو بھی نقصان پہنچا رہی ہیں۔ انسان اسی ماحول کا حصہ ہے جس میں حیوانات، نباتات، چرند، پرند سب متحرک ہیں۔ اور اگر وہ اپنے کسی عمل کے ذریعہ اس ماحول کو گدلا کرے گا تو اُس عمل سے منفی رجحان یا ردِ عمل پیدا ہوگا۔ یہ منفی تبدیلیاں اس ماحول سے منسلک ہر شے، بشمول انسان خود، پر اپنا گہرا اثر چھوڑتی ہیں۔ جیسا کہ وقت کے ساتھ آہستہ آہستہ طرز زندگی بدلتا گیا اور مٹکوں اور مٹکوں کی جگہ پلاسٹک کی بوتلوں نے لے لی۔

آپ ہمیشہ سے یہ تو پڑھتے آئے ہوں گے کہ عمل کا ردِ عمل ہوتا ہے۔ ردِ عمل کو مزاحمت بھی کہا جاسکتا ہے جو کسی عمل کی مخالفت کرتا ہے۔ سوچ کے اس زاویے میں اگر ایک اور لفظ اثر شامل کر کے سوچا جائے تو ایک خیال جنم لیتا ہے کہ شاید عمل اور ردِ عمل کے سیاہ و سفید میں ایک سرمئی حصہ "اثر" رکھتا ہے جو محرک کی نوعیت اور شدت سے زیادہ اُس کے طور اور طریق سے منسلک ہوتا ہے۔ اور اگر یہ طور طریق کسی ردِ عمل کو فروغ دے، خاص طور پر منفی معنوں میں تو کیا اس امر کی ضرورت نہی کہ طرزِ عمل پہ نظر ثانی کی جائے؟ اس تمہید اور مضمون کا مقصد دراصل ہم اکیسویں صدی کے ذہنوں کو اپنے روز مرہ کے اعمال، عادات اور طور طریق پر نظر ثانی کرنے کی طرف اشارہ دلانا ہے۔



SNOW-PACKED NORTH

INVESTIGATING SNOW
THAT FEEDS AN ENTIRE COUNTRY



The Himalaya-Karakoram-Hindukush (HKH) mountain ranges from the northern front of high mountains in the Upper Indus Basin of Pakistan.

There is little knowledge regarding the seasonal snow that falls on land and on ice across the HKH mountains. A significant amount of river discharge in the region originates from seasonal snowmelt. However, contemporary research to investigate the freshwater sources has predominantly been confined to glaciers as opposed to highly dynamic seasonal snow in big and small catchments across the HKH. Considering the role of freshwater from these rivers in the regional agriculture, economy, and potential hazards, it is important that the seasonal snow climatology be analysed, especially under the influence of climate change.

Several studies have attempted to study regional glaciers and snow via modelling, data assimilation and satellite retrievals. However, in-situ (ground collected) data is necessary for calibration and evaluation purposes. Lack of in-situ data has limited the validation of modelled estimates and satellite-based retrievals. While government agencies like WAPDA and Pakistan Meteorology department, and NGOs such as the Aga Khan Agency for Habitat have been collecting snow depth data at several locations in northern Pakistan, there is no record of snowpack characteristics (such as snow density, snow grain size, and snow temperature) or the dominant processes that control the snowpack formation and decay.

The Centre for Water Informatics and Technology (WIT) at LUMS is determined to fill this gap in the current understanding of seasonal snow characteristics across northern Pakistan. WIT has installed telemetry-based sensors to measure snow depth in a snow-dominated catchment (Gabin Jabba, Swat). Moreover, WIT researchers are using state-of-the-art computational methods to fuse the ground-based data with satellite-based



remote sensing estimates in various catchments of the HKH.

These indigenously developed sensors have measured snow depth and runoff at several locations within a catchment in the Swat district for the past three years. In order to convert the snow depth measurements into snow water equivalent, information about snow density is required.

Snow water equivalent estimates are an important part of an ongoing water balance study across this catchment. Therefore, WIT has been busy with computing the regional water balance, especially as pertains to snowmelt and runoff. This information is useful in forecasting floods/droughts and water scarcity indicators. In addition, regional initiatives such as the NASA High Mountain Asia Team (HiMAT) projects will also find the in-situ measured data useful for model and satellite-retrieval validation purposes.

Genesis of the Project

A culture that invites curiosity, encourages exploration, and empowers scientists and engineers of SSE to challenge and test themselves is vital to fostering innovation. Mr. Zahoor Ahmad, a Research Engineer at WIT, and with an MS in electrical engineering at LUMS, came up with the idea to use ultrasonic level measuring technology for snow level measurement, which led to a whole research domain at the center.

Mr. Zahoor, a native of Swat, was well aware of the impact of climate change on the communities in mountainous regions. He came up with the idea of reconfiguring WIT's digital canal gauge technology, originally developed for monitoring irrigation canals in the plains of Punjab. His curiosity led to a modification of the electronics to

monitor snowfall and snow level on the mountain across the season and use that to predict water flow and floods downstream. The catchment area of Gabin Jabba, part of the Kabul River basin in Swat Valley, was selected to pilot the concept. Back in 2018, Gabin Jabba was not yet opened as a tourist destination, and the road access to the area was poor. There were regulatory challenges concerning deploying telemetry equipment that also needed to be addressed



Deploying sensors in extreme weather and hard to access areas was quite challenging. The technology had to be robust enough to work at low temperatures and light enough to be carried to the mountain top while reliable enough to limit maintenance visits. "It is vital to do robust simulation and lab testing before embarking on a field journey," said Mr. Zahoor. He tested the equipment under extreme temperatures and worst-case scenarios before deploying them.

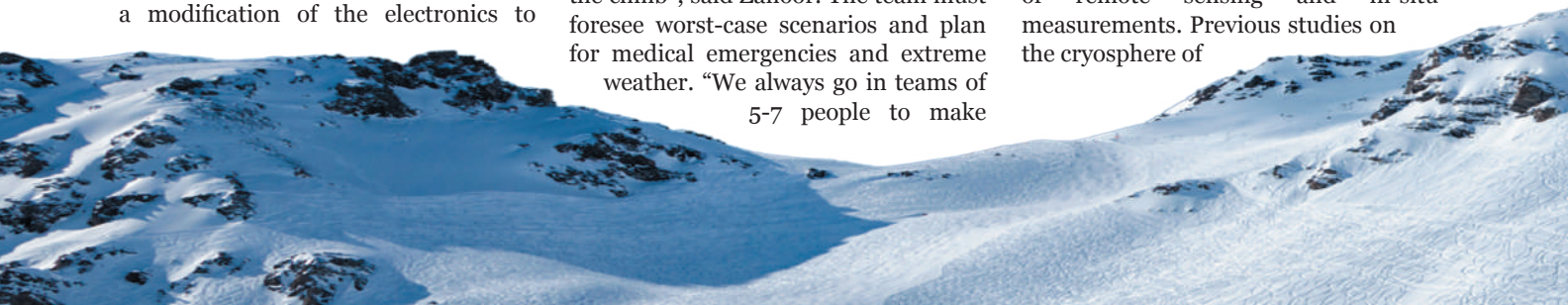
Field deployment at higher altitudes comes with challenges that need careful planning and preparation. Climbing the mountain with weight needs extreme fitness. "I used to run 10-15 km at LUMS before traveling to Swat for deployment to ensure my body supports me during the climb", said Zahoor. The team must foresee worst-case scenarios and plan for medical emergencies and extreme weather. "We always go in teams of 5-7 people to make

sure any medical emergency can be sufficiently addressed, and there are enough people to carry the sick to the help", mentioned Zahoor.

Initially, the sensors were deployed at lower altitudes. In 2019 the team deployed sensors at 12,000 feet and another one at 12,800 feet in 2020. The sensing parameters have also been improved. What started as snow level monitoring is now evolved into a complete weather station that measures solar radiation, wind speed, temperature, and soil moisture levels, which has applications in water resources management research, climate change study, and disaster risk reduction in these little-studied foothills of Upper Indus Basin (UIB). This network of weather stations and stream gauges has predicted seasonal events even when there is no snow. For example, the stream flow gauges installed in the Gabin Gabba valley served an early warning system for flooding in the Kabul River during heavy rains.

One Thing Leads to Another WIT Director and SSE faculty, Dr. Abubakr Muhammad, put forward an idea to extend the estimation of snow depth for the whole catchment using satellite remote sensing to observe the overall water budget of the valley. The purpose was to validate ground data through the measurement obtained from satellite remote sensing. The idea coincided with the establishment of the NCRA Agricultural Robotics Lab (NARL) at LUMS, in which water efficiency and environmental conservation were set as major goals towards protecting resources for Pakistan's agriculture.

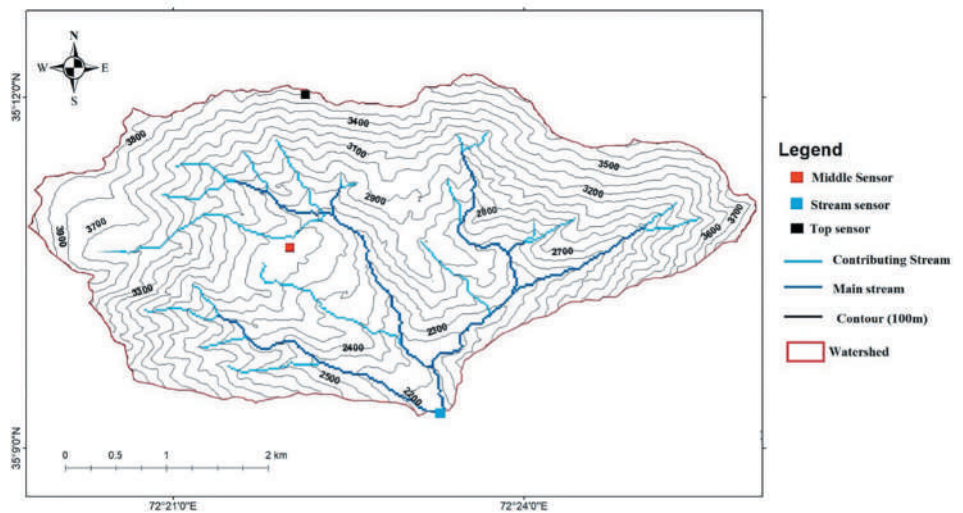
With this objective in mind, Mr. Muhammad Sohail (research associate, NARL) teamed up with Zahoor's team to conduct research from 2018 – 2021 on catchment-level seasonal snowpack monitoring, using a combination of remote sensing and in-situ measurements. Previous studies on the cryosphere of





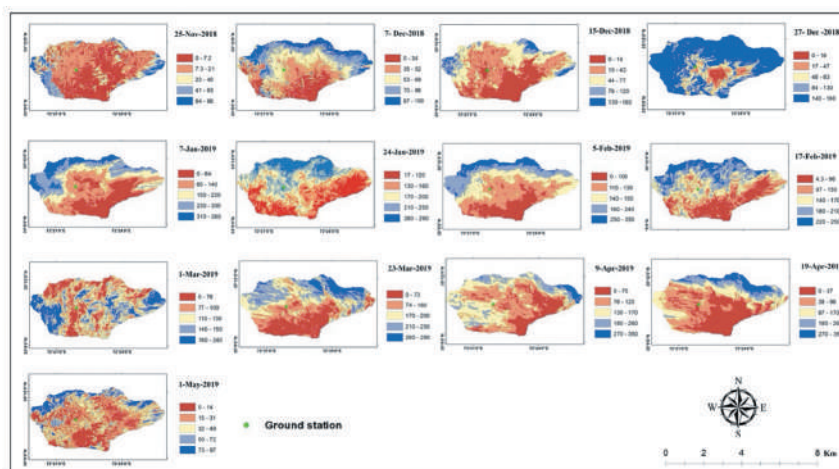
the Upper Indus Basin (UIB) have mostly focused on glaciology and have either used remote sensing tools or sparsely deployed ground station networks at the regional or basin scales. Mr. Sohail also a native of Swat, used both his knowledge of the region and his training in remote sensing (from IST, Islamabad) to work on this challenging application.

To estimate the snow depth at the catchment level, Sohail's team has processed Sentinel-1A (C-Band) data and validated WIT's estimates by an indigenously developed ground-based monitoring station. He has used differential interferometry for the inversion of spatial snow depth from November



2018 to May 2019. The results indicate a spatial maximum of 350 cm snow depth within the catchment and a temporal maximum of 216 cm at the validation point. The relative error (RE) with respect to the ground station was estimated to be 90% and an RSME of 3.0cm for the mean snow depth range up to 229cm. The good performance of TOPS data with spatial-temporal baselines and inexpensive in-situ validation offers significant potential in future applications of snowpack monitoring and water resources management studies in the Upper Indus Basin of Pakistan.

This work is being submitted for review at a top journal on the remote sensing of environmental systems. Sohail and Zahoor's work further shows the great potential for extending these scientific tools to other catchments and watersheds in the regions. It also demonstrates the impact highly trained and motivated scientists and engineers can bring to their local communities.



Bringing Global Expertise to Local Problems



The WIT team working on snowpack received a major boost and international recognition with the arrival of a postdoctoral researcher in 2021. Dr. Jawairia Ahmad joined the team after receiving her PhD in Civil Engineering from the Department of Civil and Environmental Engineering, University of Maryland, College Park, USA. Her doctoral dissertation was focused on improving terrestrial water budget estimation across high mountain Asia and the adjoining region. Her research interests include the utilization of machine learning and data assimilation in Earth science.

Dr Jawairia's arrival has triggered many international linkages to boost WIT's initiatives related to snowpack and research in the high mountain HKH region. She has competitively won a CLiC fellowship which will allow her to perform field work in Switzerland and Pakistan. The WSL Institute for Snow and Avalanche Research SLF has developed several useful tools to study snow in mountainous terrain such as the Alps. Considering the similarities in the topography, it is expected that these models would benefit the study of snow across the Karakorum mountains. Thus, SNOWPACK and Alpine3D models will be used to spatiotemporally model the snow across northern Pakistan using the in-situ collected data. The overall idea therefore is to use Dr Jawairia's working knowledge of global datasets to study smaller-scale systems in extreme detail using satellite data, computer models and field work. Two sites have been selected for field measurements.



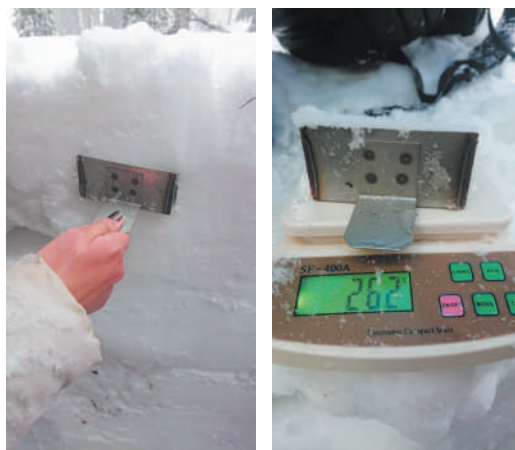
The first site is Gabin Jabba (average elevation 2582 m.a.s.l.) where WIT snow depth and streamflow measuring sensors are already installed and are monitored by affiliated team members residing there. Secondly, Skardu (2228 m.a.s.l.) where seasonal snow persists for a longer period and where WIT faculty including Dr Jawairia and Dr Abubakr intend to forge a major curricular partnership on water resource management with the University of Baltistan. Prior to the fieldwork, the topology, vegetation, and satellite-based seasonal snow patterns will be analysed to select the most suitable transect along which snowpits will be dug.

A team lead by Dr. Jawairia travelled to the proposed sites and collected in-situ snowpack data along the planned transect.

Snowpack characteristics such as snow depth, snow density, snow grain size, ice layers, snow hardness, and temperature was measured.

The collected measurements are to be digitized and quality checked prior to storage in standard geographic data

formats. The collected measurements will then be visualised and analysed to discern any apparent spatial patterns in snowfall due to complex topography and forest vegetation.



The spatiotemporally modestimates derived from these field measurements will be evaluated using the snow depth data collected by the currently installed WIT sensors and the independently collected AKAH measurements of snow depth (wherever available). Also, independent satellite-based retrievals and data assimilated estimates will be compared with the in-situ measurement-based model output (SNOWPACK and Alpine3D estimates) to a characterise biases in satellite retrievals across the Karakoram mountains.

Data Dissemination

The collected and modelled datasets are available for public usage on WIT's website: <https://wit.lums.edu.pk>

Conclusion

In conclusion, science is a highly interdisciplinary and complex enterprise that thrives on creativity. A few years back, no one would have thought LUMS will have a major research initiative and field presence in the high mountains studying snow. It started with the curiosity of a single research associate, it made progress with the encouragement of a visionary leader, it grew with the addition of experts in new areas, and it is now thriving with the help of local and international partners.

Research Team



Dr. Abubakr Muhammad

Associate Professor & Chair, Dept. of Electrical Engineering, Executive Director, Center for Water Informatics & Technology (WIT), SBASSE



Dr. Jawairia Ashfaq Ahmad

Post-Doctoral Fellow and Adjunct Faculty Member



Zahoor Ahmad

Research Associate



Mohammad Sohail

Research Associate (Remote sensing and GIS analyst)

BAANG! بانگ!

Access Reliable Health Information with Your Voice!

Roshaan Bukhari

There's no doubt that social media is a microcosm of information, that covers a great swath of topics.

Tweets and touts relaying public policy, to messages that have been forwarded many times spreading misinformation regarding something as serious as COVID-19, the landscape of social media is fertile for the growth and spread of both correct and incorrect information. However, healthcare is a serious issue and laying down a misinformation mine can prove fatal in some cases. Therefore, researchers at SBASSE have created Baang – a digital platform where you use your voice to access reliable healthcare advice!

But why develop a voice-based service? Over the last two decades, voice-based social media platforms have been enabling people who are poor, remote, and low-literate to still get the benefits of the internet.

These platforms allow users to call toll-free phone numbers to record voice messages in their local language and listen to and react to messages recorded by others. Mobile Vaani connects over five million people to infotainment in the media-dark regions in India and CGNet Swara enables rural communities to listen to local news and report grievances. The paper outlines the need for creating a new, versatile application experience. Many scholars have examined the vital role that mainstream social media plays during crises and disasters, for example, by establishing rapid and direct communication channels from authorities, providing support and information to people in need, and bringing to light the challenges on the ground.



However, there is a scarcity of research on how voice-based social media platforms are used during public health emergencies by users who are predominantly low-literate and low-income.

To fill this gap, the research team examined three strategies to foster engagement with and dissemination of trusted information: **(1)** encourage users to access a curated list of approved health guidelines, **(2)** provide them incentives to engage with and propagate trusted COVID content, and **(3)** prompt them to reflect on their COVID-related information behaviours. Over a six-month deployment, the platform received around half a million calls from 12,000 users, who were predominately low-literate, low-income men from across Pakistan, with 96% having less than ten years of education. These users recorded over 35,000 audio posts, played them over 2.4 million times, voted on them 322,000 times, and shared them with other users over 130,000 times. The paper also mentions that users approached with all three strategies showed comparatively higher engagement with authentic COVID information. The engagement was not limited to messages being played by the users and included users recording their own COVID content and engaging with and sharing credible content widely with their peers. Users adapted the platform to meet their specific informational, emotional, and instrumental needs.

The findings highlight knowledge engagement as being more meaningful and relevant for information campaigns compared to user engagement with the platform and its features. Our work provides critical insights on how social media platforms can foster user engagement with credible content and, in doing so, makes two important contributions: **(1)** A six-month deployment of a voice-based social media platform in Pakistan, providing insights into how communities with low literacy rates engaged with credible health information during the COVID pandemic, **(2)** A mixed-methods analysis that evaluated the efficacy of three design strategies to foster user engagement with health information.

The hope is that through Baang, a major population from the global south, and especially the underserved communities within the Indo-Pak region can get reliable access to health information, navigating safely around the abyss of misinformation found in abundance across social media.

PRUNED TO PERFECTION

Under the supervision of Dr. Murtaza Taj, the thesis work of his MS students Shehryar Malik, Muhammad Umair Haider, Omer Iqbal, has been published online.

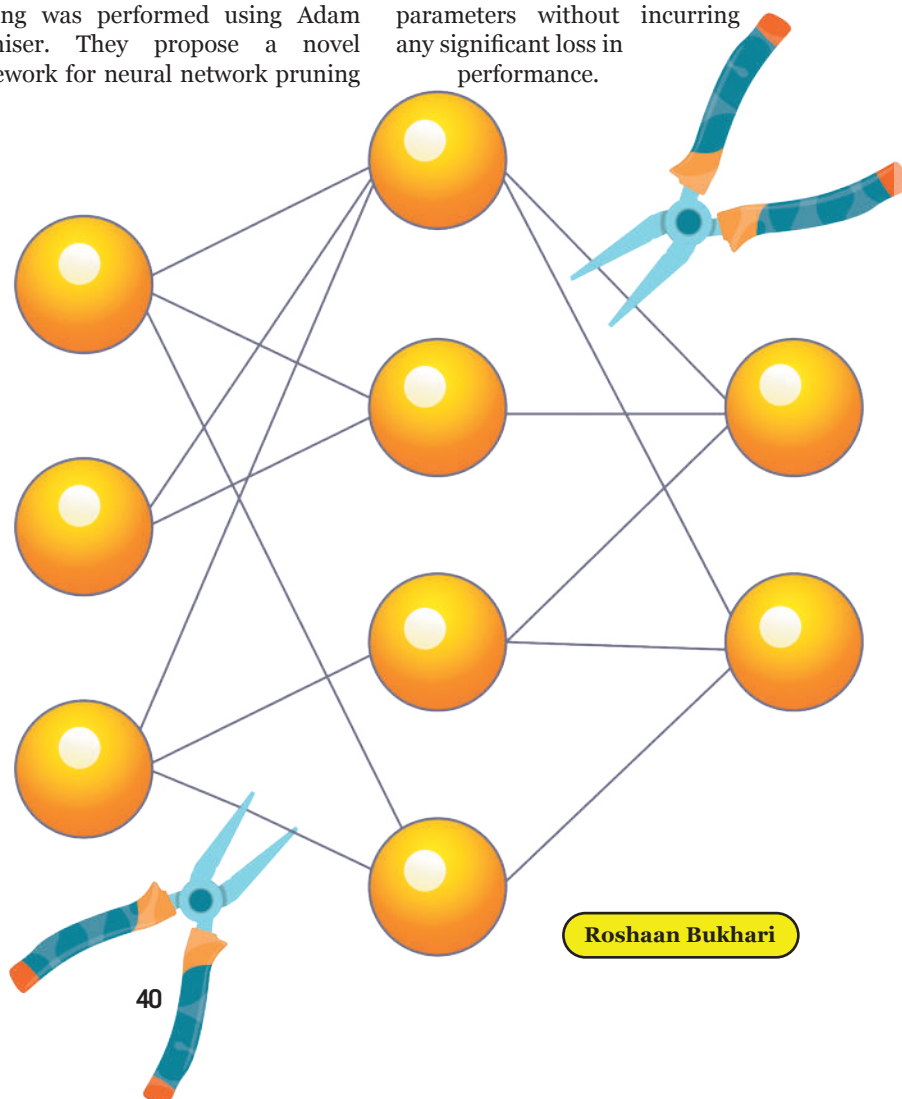
This includes two MS thesis, one of which is based on neural network pruning through constrained reinforcement learning (CRL), which will be featured in this story.

In agriculture, pruning is cutting off unnecessary branches or stems of a plant. In machine learning, pruning is removing unnecessary neurons or weights. Network pruning reduces the size of neural networks by removing (pruning) neurons such that the performance drop is minimal. Traditional pruning approaches focus on designing metrics to quantify the usefulness of a neuron which is often quite tedious and sub-optimal. More recent approaches have instead focused on training auxiliary networks to automatically learn how useful each neuron is however, they often do not take computational limitations into account. In this work, the research team proposes a general methodology for pruning neural networks. The proposed methodology can prune neural networks to respect pre-defined computational budgets on arbitrary, possibly non-differentiable, functions. The team only assume the ability to be able to evaluate these functions for different inputs, and hence they do not need to be fully specified beforehand. This was achieved by proposing a new pruning strategy through constrained reinforcement learning (CRL) algorithms. The paper proves the effectiveness of the team's

approach via comparison with state-of-the-art methods on standard image classification datasets. Specifically, the study reduced 83 – 92.90% of total parameters on various variants of VGG (pretrained network), while achieving comparable or better performance than that of original networks. The team also achieved 75.09% reduction in parameters on ResNet18 without incurring any loss in accuracy.

The team evaluated our approach using CIFAR-10 dataset on ResNet18 and variants of VGG network. The training was performed using Adam optimiser. They propose a novel framework for neural network pruning

via constrained reinforcement learning that allows respecting budgets on arbitrary, possibly non-differentiable functions. There is a pro-Lagrangian approach that incorporates budget constraints by constructing a trust region containing all policies that respect constraints. Their team's experiments show that the proposed CRL strategy significantly outperform the state-of-the-art methods in terms of producing small and compact while maintaining the accuracy of unpruned baseline architecture. Specifically, our method reduces nearly 75.08%–92.9% parameters without incurring any significant loss in performance.



Roshaan Bukhari



WORKSHOP ON ANTIMICROBIAL STEWARDSHIP GOES VIRAL!

Roshaan Bukhari

**This is a story about
support earned through
amazing content, delivery,
and participation.**

The global pharmaceutical giant Pfizer has expressed its interest to continue support for Dr. Shaper Mirza's virtual course on antimicrobial resistance awareness called 'Antimicrobial Stewardship Course'!

Antimicrobial resistant infections kills 7 million people every year and if left unchecked will cause 25 million deaths by 2025. Measures for lowering the burden of antimicrobial resistance includes regulation of prescriptions, improvement in vaccine uptake and vaccine delivery, development of awareness and finally surveillance of resistant organism in community and in hospitals. Surveillance at both community and hospital levels is key to lower the burden and preventing unnecessary infections. Dr. Shaper Mirza thinks that to lower the burden of resistant infections acquired in a hospital setting, a vibrant antimicrobial stewardship program is critical.

Components of a viable antimicrobial stewardship program include appropriate dosing of medicine, regulation of the duration and route of administration of antimicrobials and identification of hotspots in the hospital that are potential reservoirs of antimicrobial resistant infection transmission and finally devising strategies to mitigate the risk of such infections. "The course was therefore developed with the singular goal to provide training to the participants on how to optimise clinical outcomes while minimising unintended consequences of antimicrobial usage", says Dr. Shaper.

Overall, the course was a huge success, which was evident by the fact that every single day it saw at least 150 participants logging in.



Visual Poetry with Fukaya Category

Dr. Haniya Azam

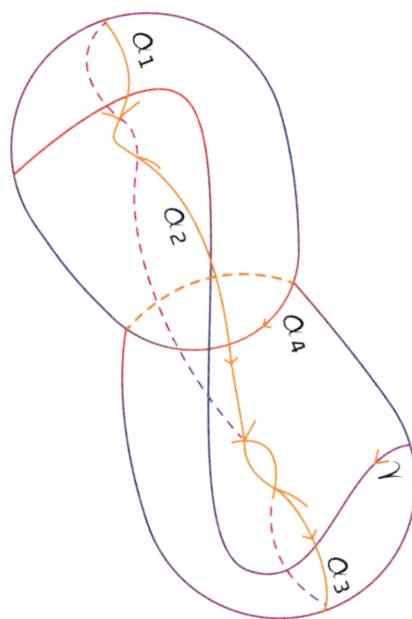
Many claim that math is the language of the universe; string the words with careful deliberation and you might end up with an almost poetic reconstruction of reality.

Contrary to most school level pedagogy, mathematics can be perplexingly enriched with visuals, a form of visual poetry. In a universe that binds us in three spatial dimensions, mathematics is the ultimate liberator that lets us imagine, quite tangibly, the possibilities of dimensions higher (and lower) than what we can experience. Be it a daedal tesseract, or a complex reconstruction of the Mandelbrot set, mathematics has an innate power to inform our wildest imagination.

Fukaya category is one startling example of the many ways in which complex mathematics can be expressed through the study of surfaces and topology.

Dr. Haniya Azam is an Assistant Professor at the department of mathematics who is the first author of a paper which has been published in the Journal of Pure and Applied Algebra, one of the most well reputed journals of mathematics. Dr. Haniya's paper tackles the complex topic of mathematical surfaces called Fukaya category, a mathematical concept whose applications spill over to other disciplines, such as in the famous string theory, by providing vital support for the mirror symmetry conjecture.

This research constructs the topological Fukaya category of a surface with genus greater than one, making this model intrinsic to the topology of the surface.



Pictured above:
non-separating curves on a
surface of genus two.

In their paper, Dr. Haniya and her team review the definition of Floer homology for unobstructed curves. Floer chain complex will be generated by intersection points, which requires the usual transversality condition on the pair of curves giving these intersection points. Defined in this naive manner, their chain complexes are not invariant under isotopy. For a given choice of disjoint representatives of two curves the intersection could be empty, whereas a little perturbation may give rise to intersection points.

Instead of using the area form of the surface, the researchers use an admissibility condition borrowed from Heegaard-Floer theory which ensures invariance under isotopy. The paper shows finiteness of the moduli space using purely topological means and compute the Grothendieck group of the topological Fukaya category.

Dr. Haniya Azam is an Assistant Professor at the Department of Mathematics

Out From the Deep

Seaweed as a promising source of biofuel

Roshaan Bukhari

Members of the very specie that accessed, utilised, and exploited fossil fuels for centuries, are now campaigning against it. Collectively, we'd start blushing out of embarrassment if a report card on our upkeeping of the environment were to be worn as a lanyard.

But blush not – the seaweed are here!

Seaweed, as a third-generation biofuel feed-stock, could potentially circumvent many of the challenges posed by traditional fossil fuel alternatives, as it requires no arable land, fresh water, or fertilizer for cultivation and exhibits a higher biomass yield per unit area of cultivation than its terrestrial counterparts. Unlike lignocellulose, macroalgae have almost no lignin; therefore, their sugars can be released by easier and more economic operations. Seaweed cultivation could also directly improve the marine environment by removing CO₂, heavy metal pollutants, and dissolved nutrients that would otherwise cause eutrophication.

This study conducted by Dr. Rofice Dickson and his colleagues evaluates the environmental impacts, economic potential, and makes a case of producing bioenergy from seaweed via biological conversion pathways, including the sugar pathway; volatile fatty acids

pathway; and methane pathway to produce ethanol, heavier alcohols, heat and power respectively. Much like any other form of plant-based agriculture, seaweed production consists of two stages: cultivation and harvesting. Cultivation can be subdivided into four stages: the collection of fertile seaweed; spore release and sporophyte formation; rearing and nursing of seedlings; and offshore cultivation. The harvesting consists of activities related to the collection of seaweed from the sea and their transportation to a harbor.

The maximum seaweed price and minimum product selling price are both calculated as economic indicators. Overall, results demonstrate that the sugar platform is economically superior, as it provides a higher average maximum seaweed price of USD 121.6/t compared with USD 57.7/t and USD 24.2/t for volatile fatty acids platform and methane platform, respectively. However, the study also concluded that production via fermentation is so far the best alternative for energy production since it led to better economic and lifecycle outcomes.

A seaweed biorefinery could be located near a city close to the shore, which will provide necessary infrastructure and labor, such as Karachi. A seaweed cultivation site in Republic of Korea, with a distance of 15 km from the shore to the biorefinery, was considered for the analysis of terrestrial transportation. The main challenge

in seaweed transportation is its high moisture content of 85–90 wt%. If the biorefinery is located far from cultivation sites, hauling wet biomass significantly increases transportation costs. Seaweed-based food companies utilize artificial drying to optimise the storage time. When being sold as a food product, the high seaweed price compensates for its high drying costs.

Although this study provides deep insight into the economic and environmental sustainability of green energy extracted from seaweed via biochemical pathways, some barriers to large-scale deployment of seaweed biorefineries, including high-quality biomass at a low price and adequate supply to meet the demands of industrial biorefineries, remain. In this regard, mechanised offshore cultivation and efficient seaweed farming techniques need to be developed to increase productivity and decrease the seaweed production cost.

DOPING MATERIALS INTO PERFECTION

Harnessing solar energy is intricately linked with tinkering of molecular structure inside state-of-the-art materials. Coating traditional silicon panels with a layer of perovskite has boosted our hopes for a better, much more efficient way of generating electricity from solar energy.



Roshaan Bukhari

It is not just light that perovskite is good at capturing. Let's talk about heat – the greatest escape artist known to the physicist. Whether the process is chemical or physical in nature, or radioactive decay; heat always manages to escape into 'the great outdoors' of a given physical system. Wishful as it may be, imagine if this 'wasted heat' could be utilised to generate electricity, increasing efficiency of a thermoelectric system. Dr. Uzma Hira, a former student of Dr. Falak Sher (Chair, Department of Chemistry and Chemical Engineering, SBASSE) is the first author of a research paper that describes just that! A chemical doping process that can create a material which shows much better thermoelectric properties than conventional materials of similar kind. The answer is Hexagonal Double-Perovskite-Type Oxides, that substitutes Barium with Bismuth. The research paper entails how chemically doped $\text{Ba}_{2-x}\text{Bi}_x\text{CoRuO}_6$ hexagonal double-perovskite-type oxides were prepared using a solid-state method and characterises its interesting thermoelectric properties.

Shown above is the hexagonal interface of a double-perovskite type oxide, which offers promise as a p-type thermoelectric material. Pictured below is double perovskite oxides having the general formula A_2BRuO_6 , where A is an alkaline-earth or rare-earth metal and B is a transition metal, show very interesting magnetic and electronic properties. The key parameter here is how effectively does a material demonstrate the Seebeck effect (named conspicuously after the Baltic German physicist, Thomas Johann Seebeck). In this fascinating phenomenon, temperature difference between two conductors can induce an EMF, generating a potential difference which can be measured. The material which Dr. Uzma's team has worked on can be conveniently identified as $\text{Ba}_2\text{CoRuO}_6$, which is doped with Bismuth for better thermoelectric performance.

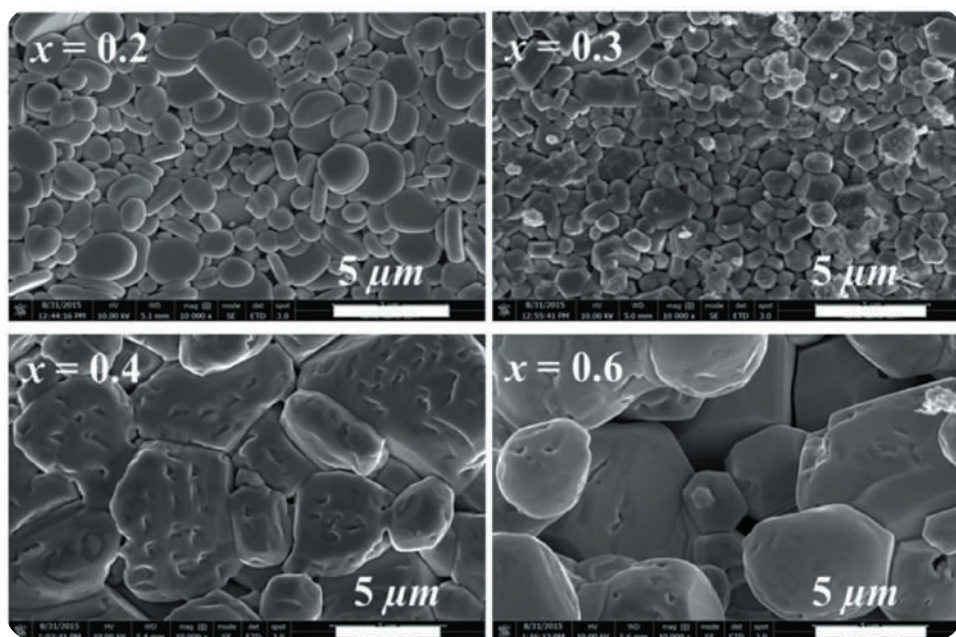
Conservative estimates suggest that about half of the total energy that we consume each year is lost to the environment as waste heat.

Thermoelectric power generation offers an attractive route for the direct conversion of heat into electric power and is considered to be an important component of a sustainable future energy landscape. In fact, one need not invest too much into imagining the future of thermoelectric promise. As you read this, rovers on the planet Mars are creating kilometers worth of trails and roving the red planet using RTG technology as their primary power source. RTG can be unpacked as Radioisotope Thermoelectric Generator. RTG's utilise the heat from the natural decay of Plutonium.

The most common thermoelectric materials are alloys of chalcogenides such as Bi_2Te_3 , PbTe , Bi_2 , and $\text{Bi}_x\text{Sb}_{2-x}\text{Te}_3$ are based on either bismuth telluride or lead telluride. These materials are relatively scarce and therefore expensive, toxic, and unstable at high temperatures. Transition-metal oxides were initially ignored in the search for potential thermoelectric materials until the discovery of high power factors in p-type Na_xCoO_2 about twenty years ago. Since then, many other metal oxides have been explored and reported as promising thermoelectric materials. Yet, the performance of most oxide materials is still lower than that of non-oxide traditional TE materials, and the effort is still ongoing in the search for efficient novel TE metal oxides.

The crystal structures of hexagonal perovskite oxides that were studied in Dr. Uzma's research were studied using XRD, SXRD, and NPD at room temperature.

Their crystal structure was heated without liquefaction (sintered) at a blistering temperature of 1150 °C. An increase in the crystalline size was noticed. This increase in the grain size, which was inferred from the diffraction data, and can be explained by the presence of Bismuth. The solid-state chemical reactions consist of four main steps of diffusion, reaction, nucleation, and crystal growth. When the diffusion rate is faster and the nucleus's growth rate is greater than the nucleation rate at the given reaction conditions, larger crystals are formed. The low melting point of Bi_2O_3 (817 °C) compared to BaCO_3 (1360 °C) suggests that the diffusion of Bi^{3+} cations will be faster than that of Ba^{2+} cations and, consequently, the crystallite/grain size will be larger in the Bismuth-doped samples for the given sintering time and temperature. Take a look at the electron micrographs obtained from this study.



ALUMNI STORY

**REFLECTIONS BY
USAMA JAVED MIRZA**

(CAMBRIDGE GATES SCHOLAR)

I've always been excited by magic. Growing up I read many fantasy fiction books such as the Harry Potter series and the Abhorsen Trilogy. Science to me was the magic I could see in the world around me. I remember reading Einstein's biography as a kid and wondered at the power of $E=mc^2$.



My father is a nuclear physicist as well, and when I would go for walks him daily he would spellbound me with strange facts of physics, whether they were about magic numbers that govern the atomic structure, or about how electric circuits actually channel energy from flowing water. It was then when I started studying Physics at LUMS that I realized just wonderfully weird and whacky, yet beautiful the universe is capable of being! Quantum tunnelling, time dilation and ball lightning are just some of the phenomena I learnt that made me see wonder everywhere in the seemingly intuitive world around me.

My Physics teachers loved a good debate, and I would love to challenge the physical models presented in class.

Our Physics batch was a total of 6 students, and so we were a tightly knit and supportive group. We'd spend hours eating samosas in the Physics department and arguing over things like whether a hamster would survive a fall from an aeroplane if it fell on its belly on muddy ground, and whether 'time' was actually an illusion. What I also loved was how encouraging my major was of interdisciplinary study. I was able to take many courses in Philosophy as well, and these helped get thinking critically about the nature of science, and also about the relations between science and religion.

After graduating from LUMS, I became a high school teacher. I taught Physics and Math with relish, and loved opening the minds of bored teenage students to exciting realities of time travel (dilation), potential multiple universes and the delight of Tesla coils. I innovated in my classroom, inspired by the exciting experimental demonstrations that Dr. Sabieh Anwar would perform in class, and the fun intellectual challenges that were posed by professors like Dr Amer Iqbal and Dr. Babar Qureshi. I went on to pursue my Masters in Education at Teachers College Columbia University on a Fulbright scholarship, and did my Masters Thesis on completely reimagining the O level Physics curriculum that is taught so dryly in too many private schools across Pakistan.

After coming back to Pakistan, I have worked as a social entrepreneur, academic coordinator, teacher, activist and science education policy maker. I am especially grateful to Dr. Sabieh, who continued to mentor me long after I graduated from SSE in 2013.

We worked together on proposing new science education policies to the Punjab government, and science education activism activities at the Alif Ailaan campaign. We also then cotaught a course at LUMS on science education for undergrads, along with Dr. Yasira Waqar! I am also very grateful to Dr. Sabieh for writing me a letter of

recommendation for the Gates Cambridge scholarship.

This work was what led me to then provide consultations to the Single National Curriculum Council for their middle school science curricula! This policy work, along with in parallel running Saving 9, the health education social enterprise I founded, gave rise to the inspiration for my PhD topic. It was also inspired by the public debate that sprung up between Dr. Perva Hoodbhoy and Dr. Abdul Nayyar (both of whom I have studied under at LUMS) and Dr. Mariam Chughtai regarding the role and impact of religion and science in school education in the context of the Single National Curriculum.

In my experience and observations, I came to realize that countless social problems are aggravated by lack of conversations around science and religion.

My PhD research at Cambridge University will try to understand how the ideological perspectives of youth in Pakistan are shaped around science and religion, as the Single National Curriculum is being rolled out to enforce minimum learning standards across the country. This research will provide rich learning on public policies for social issues and help identify roadblocks that hinder citizens of postcolonial Muslim countries from making substantial contributions to the natural sciences.

کیا آپ جانتے ہیں؟

گرم پانی ٹھنڈے پانی سے زیادہ تیزی سے جم جاتا ہے۔
یہ بات عجیب معلوم ہو سکتی ہے، لیکن اسے (Mpemba) اثر کہا جاتا ہے۔
سائنس دانوں کو یقین ہے کہ اس کی وجہ پانی کے ذرات کی ایک خاص رفتار ہوتی ہے جب وہ گرم ہوتے ہیں، جس کی وجہ سے وہ زیادہ آسانی سے جم جاتے ہیں۔
جدید تحقیق کے مطابق، اس تحقیق سے روزمرہ کی چیزوں کو بہتر طریقے سے استعمال میں لایا جاسکتا ہے، جیسے الیکٹرانک آلات کو ٹھنڈا کرنا۔

یہی وصف فزیلیب میں میرے ساتھی حافظ محمد رضوان کا طرز امتیاز ہے۔ رضوان ایک تکنیک کار ہیں جو دھات، لکڑی اور گونا گوں قسم کے پلاسٹک کے سامان سے جیتے جاگتے، اُچھلتے کودتے، رواں دواں سائنسی آلات بنا ڈالتے ہیں۔ ہوا کے دباؤ کو قابو میں لانا ہو، اپنی مرضی کے اوقات میں کوئی صوتی آہنگ بجانا ہو، بظاہر ناموس آلات کو آپس میں بے عیب انداز میں جوڑ دینا ہو، یا کوئی نہایت پیچیدہ آلہ بنانا ہو جو پچاس ہزار روٹ سہہ سکھنے کی صلاحیت رکھتا ہو اور ایک منٹ میں ایک مائکرو لیٹر جتنا مائع کسی اور مائع میں تحلیل کرنے کی قابلیت رکھتا ہو، تو رضوان صاحب ایک ہنرمند تخلیق کار کی طرح نمودار ہوں گے اور سائنسدان کی ضرورت کو عملی جامہ پہنانے کے لیے کمر کس لیں گے۔ ڈیزائن سے لے کر، ٹیریل کے انتخاب اور جدید ترین مشینوں پہ ان کی تخلیق تک کے مراحل رضوان اور ان کی ٹیم اس خوبی سے سرانجام دیتے ہیں کہ بے ساختہ واہ کیے بغیر چارہ نہیں رہتا۔

اس طرح فزیلیب کی ورکشاپ ہر ماہ لاکھوں روپے کی مالیت بچانے میں کامیاب ہوتی ہے، وہ پیسہ جو بیرون ملک درآمدات پر خرچ ہونا ہوتا ہے، اب کسی اور کام آتا ہے۔ رضوان اور ہمارے دیگر ساتھیوں کے بنائے ہوئے سائنسی آلات ہزاروں طلبہ و طلبات، خواہ وہ لمز میں ہوں یا اس سے باہر، استعمال کر چکے ہیں۔ ہماری تحقیق سرگرمیاں بھی اس تکنیکی مدد کے بغیر ناممکن بلکہ ناممکن ہیں۔

مجھے دلی خوشی ہے کہ حافظ محمد رضوان لمز یونیورسٹی کی طرف سے جاری کردہ بہترین خدمت کے پہلے اعزاز کے مستحق قرار پائے۔ وہ واقعی اپنے دست ہنر سے مس خام کو کندن بنا دیتے ہیں۔ مجھے ان کے ساتھ کام کرنے میں فخر محسوس ہوتا ہے اور میں ان کی مزید ترقی کے لیے دعا کرتا رہوں گا۔

محمد صبیح انور
پروفیسر فزکس، لمز

ایک ہنرمند تخلیق کار

جب آپ فزلیب یعنی فرس لیب کی تجربہ گاہ کی ورک شاپ میں داخل ہوتے ہیں تو خرد مشین کے عین پیچھے آپ کو نظیری کا یہ بے نظیر شعر
نویسورت خطاطی میں لکھا نظر آئے گا۔

نیست درخشک و تربیشہ من کو مابہی
چوب ہر نخل کہ مہر نہ شود، دارنم

اس کا مطلب بڑا دلچسپ ہے۔ شاعر فرماتے ہیں کہ میرے صحرائیں کوئی بھی خشک یا تر چیز ایسی نہیں جو بے کار ہو۔ اگر میں دیکھوں کہ کسی درخت
کی لکڑی مہر و مخراب جیسی شاندار چیز بننے کے قابل نہیں، تو میں اُسے بھی استعمال میں لے آتا ہوں، چنانچہ میں اُس سے دارِ مشکل بنا ڈالتا ہوں۔





DEPARTMENT OF LIFE SCIENCES

SBASSE is pleased to announce that the new name for the Department of Biology will be the Department of Life Sciences.

Ushered by the discovery of genetic material that determines lifeforms, and the development of the "central dogma" of biology, biological sciences in the twenty-first century are radically different from a hundred years ago. For example, the biology of today forays deep down into molecular origins and is often propelled by formidable algorithms. The silico and the vivo have therefore blended into one unified whole.

Public health has also taken an altogether new meaning, especially in the past three years, be it through the hunt for

the cure of diseases that are of a truly global import, or the processing of data related to the administration of health services to large populations.

Translational research promises to shrink the gap between benchtop and the patient's bed.

The rapidly increasing knowledge of exoplanets has also opened potential life habitats beyond our very own.

To keep up with these new trends, new skills are becoming central to the discipline of biology. These skills include paradigm shifts in how we think, how we compute, and how we predict. A case in point is the study of the brain itself, which is often hailed as the last unconquered frontier. The discipline requires a melding of neuroscience, cognitive psychology,



anatomy and function linkages, radiological techniques for functional imaging and systems biology.

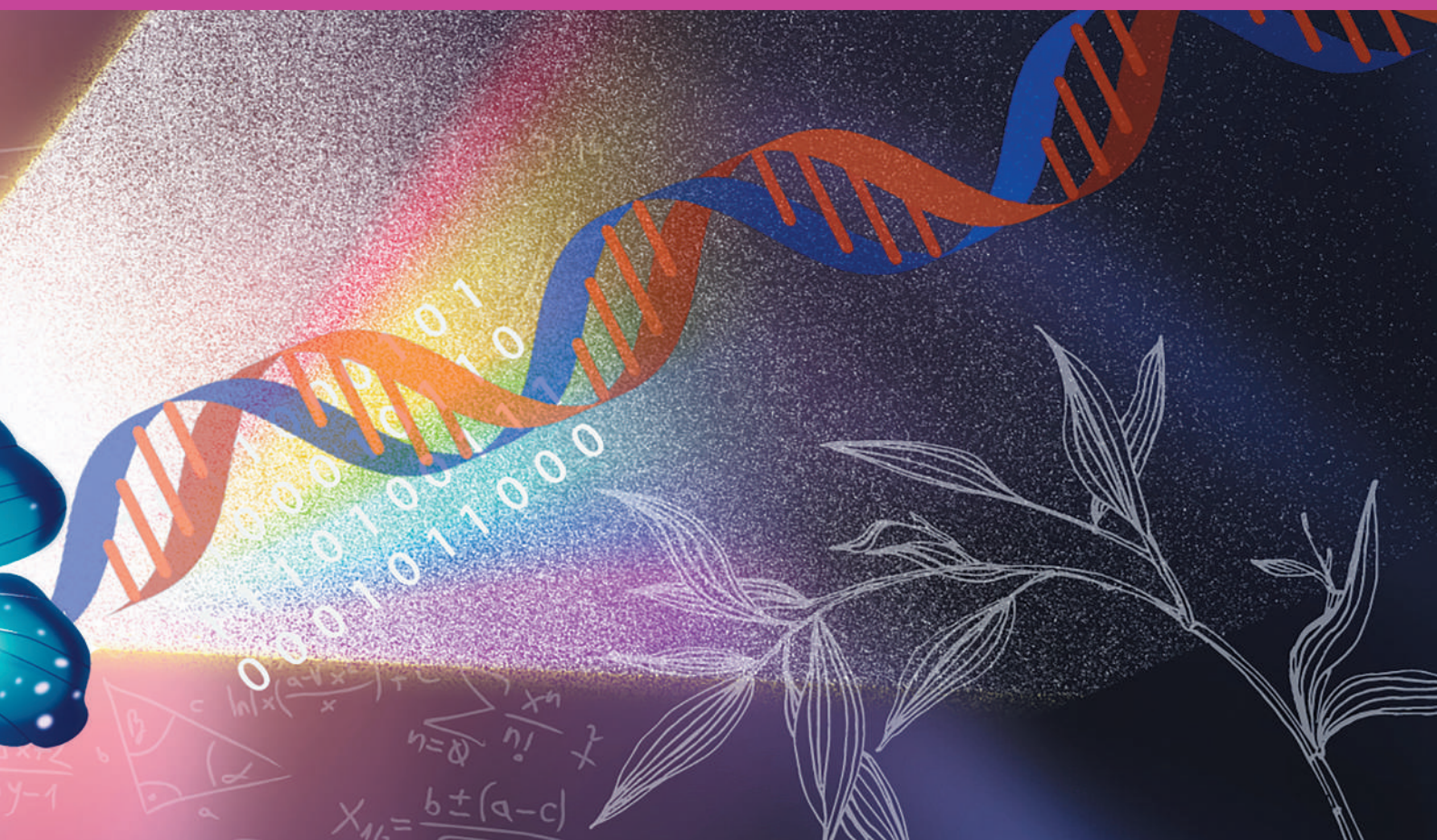
In summary, starting from Galen's medicine, through Avicenna's treatise on Shifa, all the way up to Darwin's monumental idea of natural selection, Mendelian genetics, and Craig Venter's genomic revolution, we are now in a new world that studies life from the lens of systems, complex networks, instruments, noise, quantum information, and algorithms. The overall goal is to tackle disease, prolong life, and democratise modes of therapy.

All in all, we see a shift in the focus of biology from the encyclopedic collection of "facts" to exploration of "ideas", from the "petri dish" to the "algorithm", from the "flower petal" to the "forest", and from the "what" to the "why".

A new semantic reflects this shift in thinking.

I believe the name change from "biology" to "life sciences" adequately captures this revolutionary new mode of thinking, which we know that the Biology Department in the Syed Babar Ali School of Science and Engineering has proudly espoused in the past 14 years. With an increased emphasis on informatics, applied health, agriculture, plants, ecology, and the fusion of the old with the new, please join me in congratulating our biologists in becoming LUMS's and SBASSE's citizens under the new banner of life sciences.

Message from Dr. Muhammad Sabieh Anwar
(Professor of Physics and Dean, Syed Babar Ali School
of Science and Engineering)



NEW FACULTY

DR. ZAIGHAM SHAHZAD

Dr. Zaigham Shahzad has joined the Department of Life Sciences as a Associate Professor on tenure track.

Dr. Zaigham completed his PhD and MS from Montpellier SupAgro in France in 2010 and 2007 respectively. He has worked as postdoc in his alma mater, followed by research stints at the Glasgow University and since 2020, at the John Innes Centre which is a world renowned Centre in plant and microbial sciences.

Dr. Zaigham is an established researcher in DNA methylation, evolutionary biology and the translation of genetic code to phenotype, especially in plants. He has several revolutionary discoveries to his credit, an article under review in The Cell which is one of the most prestigious journal in all of sciences and at least two published articles in Nature Communications. He was also the speaker for The Great French Advances in Biology Prize Lecture in 2007, where he spoke about “How plants perceive and respond to flooding”. Dr. Zaigham’s presence in Biology and SBASSE will strengthen its emphasis on plants and agriculture.

PROMOTION

DR. ADAM ZAMAN

Dr. Adam Zaman from physics has been promoted to associate professor and awarded tenure.

Dr. Chaudhry obtained his PhD in Physics from the National University of Singapore (NUS) in 2013 and continued working there as a post-doctoral fellow before joining LUMS in August 2014.

His research focuses on harnessing the power of realistic quantum systems with a particular focus on the dynamics of open quantum systems in the strong system-environment coupling regime.

He is an avid teacher and is known for his ability to fuse passion and rigor in the classroom. Resorting to computational digressions to bring home complex ideas in mechanics, condensed matter physics, atomic-laser physics and quantum mechanics, he is popular and highly respected among many students.



DR. ASIM KARIM

Dr. Asim Karim is one of the country's leading scientists in data mining, machine learning and applied artificial intelligence.

A pioneer of computing at LUMS, his current research directions include text categorisation and clustering, deep learning, social media analytics, and causal analysis and inference from observed data. Dr. Karim has authored two books and more than 25 journal papers and is a highly cited researcher. Dr. Karim is also the director of the Knowledge and Data Engineering (KADE) Lab at the Syed Babar Ali School of Science and Engineering.

His work on accessibility and techno-social integration of migrants, refugees and dispossessed communities keeps him at the forefront of national initiatives on technology inspired solutions.

DR. MUHAMMAD TAHIR

Dr. Muhammad Tahir is recipient of the EE Distinguished Teaching Award.

His research focuses on the development of novel algorithms for satellite navigation receiver technology, receiver baseband signal processing algorithm design and development, Bayesian signal processing, detection and estimation theory, channel coding in communication networks, machine learning and sequential Monte Carlo methods. This is a truly diverse portfolio!

Since 2016, Dr. Tahir has also been part of the Summer Research Training Program, which is a free-for-all program focused on hands-on training covering topics like signal processing basics, wireless communication, and machine learning amongst many others, a program that is open for students both within and outside of LUMS.





ABDUS SALAM POSTDOCTORAL RESEARCHERS

One year postdoctoral position at SBASSE

Context and Background

In order to become trailblazers in research, our universities and research institutes, must establish an exemplary research culture. Alongside the secondary needs of cutting-edge equipment and facilities, the primary determinant is investment in human resource. Such an investment involves nurturing available talent, and searching for the proper talent, which manifests in the form of young inquisitive students, early-career researchers and experienced faculty members.

At the Syed Babar Ali School of Science and Engineering, a considerable amount of attention has been placed in facilitating the training of graduate and undergraduate students. For example, every year about >20 students graduate with a PhD degree, with an average graduation duration of 5 years. We also train around 200 Masters students and about a thousand undergraduates. Besides, our ecosystem comprises a thriving segment of visiting or short-term researchers.

Project Rationale

When we look at global practices and standards, we notice a large discrepancy between what is considered the norm in Pakistan, and international standards. Globally, after completion of a PhD, graduate students (especially those wishing to stay in academia) progress by becoming post-doctoral fellows, as opposed to immediately becoming the assistant professors. This line of progression is now a common practice globally, as well as on a regional level (see, for example, <http://physics.sharif.ir/~web/people/>).

A post-doctoral researcher is generally far more independent than a graduate student; although he/she still requires a research supervisor, typically a faculty member. Research scientists and researchers are routinely expected to come up with their own individual research ideas, plan their research

projects, and eventually find ways in which their research overlaps with the supervisor's research, and ultimately execute them. Additionally, they are generally expected to help in applications for research grants.

In short, a post-doctoral researcher is very similar to a young faculty member, but without the typical teaching responsibilities. This is an important distinction as students who have completed their PhD are able to gain the invaluable guidance that comes in the form of post-doctoral training. They will be provided with the necessary knowledge and access to platforms, allowing them to enhance their grounding in the subject, and prepare for important pedagogical and research roles.

As mentioned before, post-doctoral research fellows typically work in research groups headed by a faculty member, enriching the overall brainpower of the group and advancing the overall research direction. By bringing experience from previous research groups, post-doctoral fellows can enhance the quality of research output within their host universities, by injecting fresh ideas and ushering adventurous approaches towards problem solving and futuristic discovery.

Objective Accelerating the Path to Global Impact

In SBASSE, we are creating the Abdus Salam Post-doctoral Research Programme, with funding derived from the Abdus Salam Chair endowment, a resounding honor to Pakistan's only Nobel Laureate in science and physics.

With thriving educational programmes, and an active faculty, whose publications find place in the world's top ranked and most celebrated journals and conferences, and the vast magnitude of grant generation activity currently underway, it has been long felt that the addition of post-doctoral fellows to the ecosystem will not only fill an important gap, but also help accelerate the path to global impact.

This Abdus Salam Post-doctoral researcher is aimed at recruiting international post-doctoral research fellows, who display advanced skills and research perspectives, from. By sponsoring these early-career researchers, who have received their doctoral degrees from across the globe, we will encourage the development of a collaborative research environment that is internationally engaged and allows these post-doctoral fellows to deepen their expertise and acquire new skills, and also enrich the SBASSE LUMS ecosystem.

By focusing on graduates from international universities, we will be able to make indispensable contributions to the current research productivity and overall enhance the university's international profile, enriching the cultural and research diversity at campus.

During their tenure at SBASSE LUMS, the post-doctoral fellows are expected to challenge our faculty to consider new research directions, mentor graduate students, thus freeing up faculty's time, and therefore the initiative promises to have a significant impact on the shared goals of promoting discovery, creativity, and innovation.

This fellowship will integrate researchers who have enjoyed international training and allow them to promote a connection between their home universities and LUMS at large.

Expected Impact

- Enhance the creative and innovative potential of researchers holding an international PhD and wishing to diversify their research goals and skills through the high-quality training and experience LUMS faculty can offer.
- Strengthen Pakistan's human capital base with better trained, innovative, and entrepreneurial researchers.
- Enhance the quality of research and innovation, contributing to Pakistan's competitiveness and growth.
- Facilitate the knowledge transfer across borders and foster a culture of open science and innovation.

To find out more about the application process, please visit

<https://sbasse.lums.edu.pk/abdus-salam-postdoc>

HOSTING CIMPA

A 10-Day Mathematics Extravaganza!

The Department of Mathematics at SBASSE hosted one of the most prestigious global gatherings in mathematics – CIMPA Research School on Algebraic and Combinatorial Methods in Geometry.

From March 1st till 11th, the team of hosts and organisers managed to provide a highly resourceful platform for creating opportunities for the researchers to work on various projects and nurturing collaborations. The 10-day extravaganza was sponsored and supported by the International Mathematical Union (IMU), Centre International de Mathématiques Pures et Appliquées (CIMPA) and the Higher Education Commission of Pakistan.

This event carried no registration fee, instead the IMU and CIMPA provided the funding for 10-days long stay to all the participants came from all over Pakistan. Most of the participants were avid learners, PhD students and faculty members from various institutes of Pakistan. Speaking about the event's international outreach, Dr. Imran Anwar, Chair of the Department of Mathematics said, "We had participants joining us from Philippines, Iran, Turkey, and Netherlands. I must say that the participants made full use of the opportunity, positively."

SBASSE would like to offer a special thanks to the Suleman Dawood School of Business (SDSB), particularly the team lead by Dr. Alnoor Bhimani, for

helping with smooth operations during the entire event. "I must say that the amazing broadcasting facility available at the venue realised the event's success.", commented Dr. Anwar.

The sessions were decorated with eloquent lectures from a team of highly skilled and reputable experts. Here's a list of the speakers and the topic of their respective talks:

Hannah Markwig
Tropical geometry

Sara Faridi
The combinatorics of syzygies

Tai Huy Ha
Containment between power of ideals

Sara Saeedi Madani
Algebraic and geometric aspects of matroids

Kaie Kubjas
Geometry of nonnegative matrix rank

Nguyen Dang Hop
Homological invariants of sequence of symbolic power of monomial ideals

Shaheen Nazir
The Orlick-Terao algebra

The lectures echoed beyond the walls of LUMS, as the content was livestreamed with a broader audience in IBA-Karachi, Iran, India, Turkey, Vietnam, and European countries. You can access all lectures and sessions by clicking on this link. The CIMPA School sessions offered celebrations of the International Women Day as well. A special cake cutting ceremony followed one of the sessions, where Dr. Kaei Kubjas, convener of European Women in Mathematics was the guest of honor. Our interview of Dr. Kubjas was featured on the official CIMPA Facebook page.

This CIMPA School was filled with cultural colors too. CIMPA fully sponsored a city tour visit for all the

participants to the walled city of Lahore. It was a wonderful expedition and lifted the spirit of the participants to discuss concepts and ideas more leisurely. "I am very thankful to my entire team in the Department of Mathematics, including Maryam Amir, Shazia Zafar, Nouman Zubair, Noreen Sohail and Qamar Hussain. They successfully organised this mammoth event and dealt with challenges gracefully and overcame many hurdles to make it possible.", Dr. Anwar mentioned, summarising the efforts of his wonderful team.

The Department of Mathematics is hopeful in bringing similar events to the School in the near future, creating not only healthy opportunities for its students but boosting interest and awareness of mathematics throughout the general community at LUMS and beyond.



A Circle That Keeps Getting Bigger!

Here's a circle that keeps getting bigger and better; the LUMS Math Circle!

What started off as a novel idea emanating from the halls of the Department of Mathematics, in the Syed Babar Ali School of Science and Engineering, as grown into a torrent of curious thoughts and engaging activities, all centered around the beautiful and visual world of Math. This growth is made possible by the combined effort of organisers, parents, and sponsors. What went down in the latest Math Circle? *Let's 'loop' in with the latest updates.*

Dr. Waqas Ali Azhar brought an enticing topic of exposing school kids to the charisma of infinities beyond our limitations. Yes, you read that right, infinities; plural). This math circle was conducted on February 18 and saw participation from as far as Nankana Sahib, with 13 students coming from that district to attend the event. In



total, around 35 students from various school and colleges attended the circle. It is probably the only forum where students from various school get an opportunity to interact with each other and engage in informal ways of learning.

So, how did it go? Dr. Waqas started the circle with a task of finding sum of first 100 number (integers) (i.e $1 + 2 + 3 + \dots + 100$). Students drilled hard to find a suitable answer where they were even allowed to use the calculators. Then he explained the genius of a famous mathematician Carl F. Gauss, who did it without using any calculator using a beautiful method.

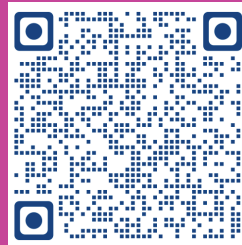
A game was played between students to come-up with the largest possible number they can write on the page within 10 seconds. As part of this activity, participants learned the role of exponents. Dr. Waqas revealed astronomically large numbers like the googol, googol-plex and Graham

number. Students were amazed to learn about the fact that Graham number is so large that the observable universe is far too small to contain an ordinary digital representation of it, assuming that each digit occupies one Planck volume, possibly the smallest measurable space. Concluding the session, Dr. Waqas wisely gave the counter-concept of infinitesimal, through the Archimede's way of approximating the value of Pi through inscribed regular polygons.

“Dr. Waqas Ali Azhar did a remarkable job and deserve huge applaud for bringing excitingly important concepts in a highly interactive manner.”, said the chair of the department, Dr. Imran Anwar. “I applaud the efforts of Ms. Noreen Sohail as well, for her dedicated organizational support.”, Dr. Imran also commented. The Chair also expressed his gratitude to all sponsors, who made the event possible and have committed to support endeavors of this wonderful initiative, including the Pak Alliance for Maths and Science and the LUMS

Students Mathematics Society.

To find out more about future Math Circle events including an upcoming mega event, please scan the following QR code.



Sekha Scholarship

(100% tuition waiver)

LUMS is pleased to announce the prestigious Sekha Scholarship (100% tuition waiver) for FSc top 10 position holders who gain admission to the Syed Babar Ali School of Science and Engineering (SBASSE) at LUMS.

This scholarship aims to encourage high-potential undergraduate science scholars to come to LUMS and acquire world-class education. Starting from the academic year 2022, the Sekha Scholarship will provide successful applicants who are amongst the top ten position holders of the national FSc examination boards, a 100% tuition fee waiver for the four years of their undergraduate degree at LUMS. FSc position holders from Year 1 or 2, from any of the 23 national FSc boards, are encouraged to apply to the Syed Babar Ali School of Science and Engineering undergraduate programmes to avail this prestigious scholarship.

For more information:

Write to: admissions@lums.edu.pk



Congratulations!

**Vice Chancellor's
AWARD**
for

**TEACHING
EXCELLENCE**

2020-2021



**Four out of five faculty members this year
have been awarded from SBASSE!**

**Dr. Rahman Shah Zaib Saleem | Dr. Haniya Azam
| Dr. Hamad Alizai | Dr. Imran Cheema**



Dr. Rahman Shah Zaib Saleem

Department of Chemistry & Chemical Engineering



Dr. Rahman Saleem is an outstanding science teacher who uses innovative pedagogical approaches to keep students excited about learning Chemistry. He makes complex theoretical content meaningful to students by encouraging multi-dimensional, out-of-the-box thinking through a variety of assessments and engaging learning activities. From tracing the historical evolution of concepts, to highlighting cutting-edge research and dominant unanswered questions, he transforms theory into applicable, real-world problems for his students to solve. As one student commented, Dr. Saleem, “...was one of those few instructors who focused on understanding rather than covering the course content” and has been a kind and caring mentor whose “...one-to-one interaction did not stumble even in quarantine as he was always one message away...” His commitments to student mentorship and partnership are clear indicators of Dr. Saleem’s dedication to helping students become the next generation of scientists who can make a difference in Pakistan and beyond.

Dr. Hamad Alizai

Department of Computer Science

Dr. Hamad Alizai is an exceptional computer science teacher who makes enduring contributions to his peers’ and his students’ learning. His commitments to improving teaching through the Learning Institute demonstrates exceptional educational leadership. To his students, Dr. Hamad “...has the gift of teaching. He has the rare ability to truly light up the classroom with inspiration.” Whether it is through peer teaching, novel discussion techniques, authentic assessments, or technology, he engages students at every level and inspires them with unwavering support and creative energies. Dr. Alizai works meticulously to give students space in class to collaborate, engage, and learn. Frequent student feedback informs his teaching and is another indication that he puts student learning first. As one student highlighted, “It is not always easy to change students’ lives, so it takes a great teacher like Dr. Alizai to do so. He is a true role model for all his students, and I learned the meaning of learning’ from him.” Dr. Alizai is deeply dedicated to learning and to sharing that learning to help others to grow and develop – and this makes him one of LUMS most treasured teachers.





Dr. Haniya Azam

Department of Mathematics

Dr. Haniya Azam is recognised by her students and colleagues at LUMS and young students who participate in Math Circles, as an exceptional teacher dedicated to helping all students master mathematics. She identifies students' anxiety about mathematics and then takes them on a journey to build their understanding of (often abstract) mathematical concepts. She does this through meticulous design of her courses, engaging lectures and demonstrations, and a range of assessment tasks and feedback. Dr. Azam invests in building learning environments inside and outside the classroom where all students feel welcome to engage, to question, and feel supported to learn. As one student said, "Dr. Azam is one of those educators who takes interest in and supports students' personal and professional development. For an institution like LUMS where students come from diverse backgrounds, instructors like Dr. Azam make this journey invigorating and rewarding." This is a true testament to Dr. Azam's unwavering commitment to going above and beyond to help her students to learn.

Dr. Imran Cheema

Department of Electrical Engineering

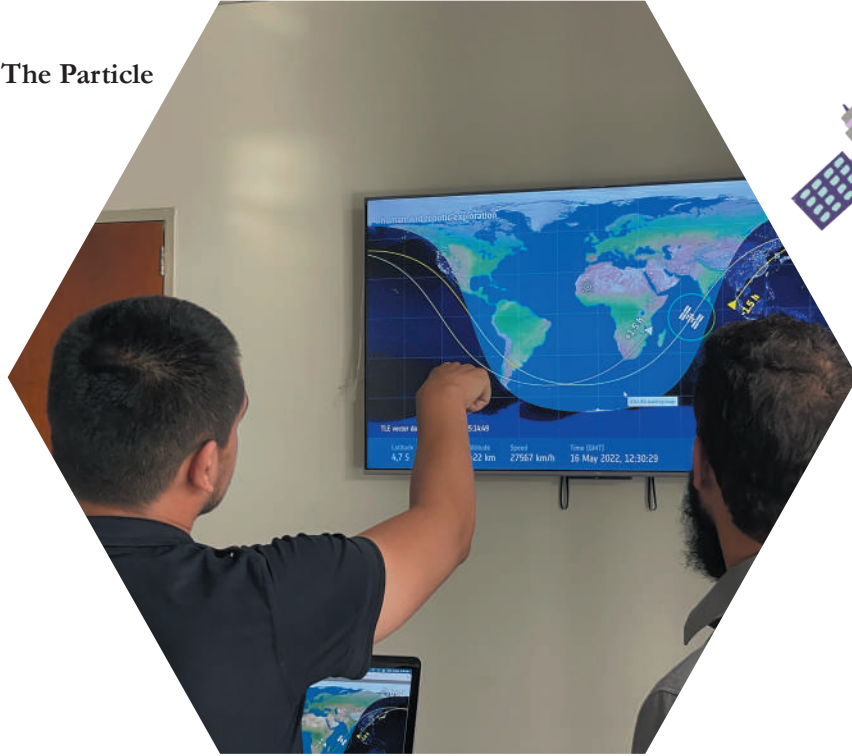
Dr. Imran Cheema's philosophy of teaching is grounded in his overarching goal to "stimulate joy in students' learning experiences" and cultivate "ah ha" moments where their learning becomes visible. As one student proudly shared, "he inculcated this sense of intellectual and scientific curiosity which was highly infectious... he would encourage me to cross more boundaries in my intellectual journey and expand my knowledge." Dr. Cheema's excellence in teaching electrical engineering has been recognised by students and colleagues for its academic rigor and how he engages students to help them learn complex mathematical and scientific concepts. Whether he is using real life examples, visualisations and demonstrations or metaphors, he aims to reach all students and help them to learn. Dr. Cheema's incorporation of varied assessment techniques and his responsiveness to regular student feedback on his teaching and course design help to ensure that student learning is at the heart of his teaching. He is without a doubt one of LUMS' most highly effective instructors, and a caring mentor who enthusiastically inspires students to love complex subjects of engineering and science.



IS LIVE

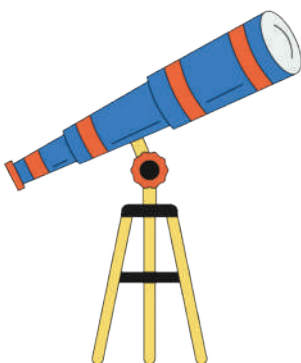
Looking over the SSE reception desk is your window to magnificent acts of nature caught live on camera, showcased in real-time for your viewing pleasure.

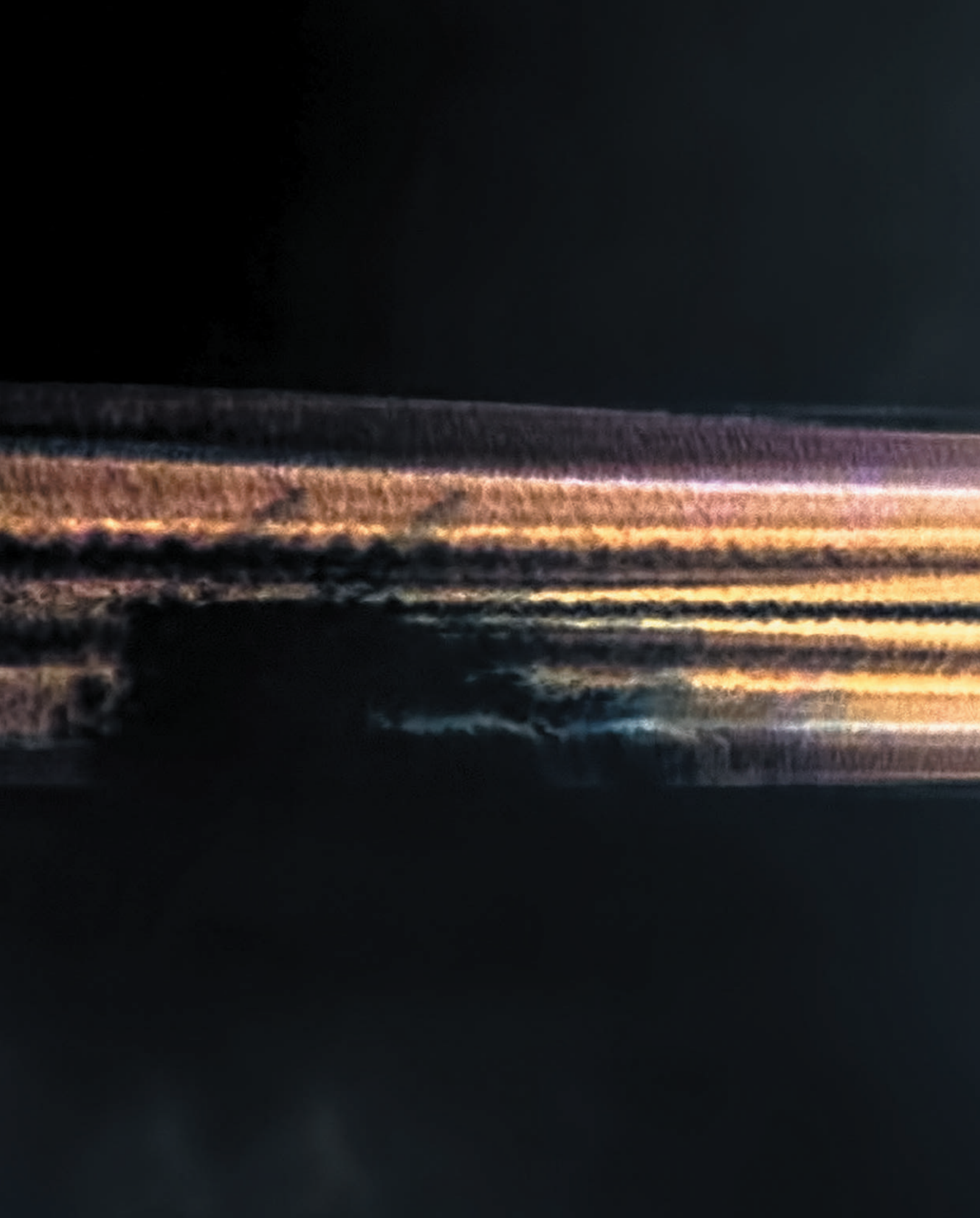




Be it the planet spinning beneath the feet of astronauts travelling at an excess of 27,000 km/h, and the wrestling of continental plates that makes the ground rumble, or the next big asteroid all set to give Earth a close shave and a good scare; the SSE Periscope will be up and running all day long.

We are launching the Periscope to embellish the SSE with an environment that piques curiosity and leaves us all wanting for more knowledge and exploration. Feel free to stop by and enjoy the sights and wonders of our home planet from the comfort of the Syed Babar Ali School of Science and Engineering.







■ Iridescent Jet Contrails

The iridescent pastel colours are sunlight diffracted by millions of water droplets condensed by the airflow over the wings. All droplets are formed through a similar process, and therefore have similar sizes, which creates ideal conditions for iridescence.

Image credits

Abdul Mateen (A. Mateen Aviation Photography).
Lahore, Pakistan

SCI 103

Introduction to Environmental Science

By Dr. Fozia Parveen

An assemblage of diverse disciplines, including ecology, materials, policy, chemistry, and human behavior, crystalised to appreciate our role in our 4,500-million-year-old home – introduction to environmental science is a course made for the students, by the students. Instructed by Dr. Fozia Parveen, this course is a gateway to ardent activism that is informed by a strong academic foundation. The course encourages students to digress into open discussions, course projects and presentations - a scenic detour from the typical classroom approach.

Embellished by the atypical engaging style of Dr. Fozia, this course is wreathed with a student-centric approach where both the instructor and students are equal in learning. Each class is usually tapered with a home task for a discussion in the following session, along with a reading list. The course is structured around 20 odd lectures, interspersed with presentation days. It covers topics ranging from plastic pollution, precision agriculture, national environmental quality standards, human behavior and littering, pollution reduction techniques and even discusses a conversation with a farmer!

Whether it's parting the curtains of our collective ignorance in terms of environmental conservation, or the fine balance between industrial boom and a cascade of environmental concerns, this course sets to inform our future tampering with the delicate biosphere of Earth. By helping establish a sense of community between the student and their larger environment, this course hopes to waft our sense of wonderment and responsibility to preserve this ecosystem.

The Particle



CHE 202

Air Pollution Spring 2022

By Dr. Shahana Khurshid

Anthropological sources, including emissions from power plants, industries, and vehicles, have decreased the quality of air that we breath over the last few centuries.

This has led to concerns over the impact of air pollution on human health and the earth. Air pollution is a multi-faceted issue. ChE 202 – Air Pollution course, will study the science behind it, the policy implications on it, and the threats it poses. The focus of this course will be the underlying science behind air pollution and how it originates. Various types of air pollutants and the sources of these pollutants will be described. Physical and chemical interactions between pollutants will also be covered. The topic of indoor air pollution will be

introduced which will also highlight the importance of duration of exposure to pollutants.

The course will move into studying some of the biological effects of exposure to air pollution, and how these effects are gauged. The apparent and projected effects of air pollution on the health of the earth will be examined. Policy interventions play an important role in the extent of air pollution. The effect of different policy interventions implemented across the world will be analysed to understand the role that policy and regulation play on air pollution. Science-based and policy-based steps to mitigate air pollution will be presented to help describe possible pathways towards achieving cleaner air. Dr. Shahana Khurshid from the Department of Chemistry and Chemical Engineering will be teaching this course in Spring of 2022 at SBASSE, LUMS.

DID YOU KNOW?

X

Air quality can be qualitatively analysed without the need for expensive and elaborate instrumentation. Rayleigh and Mei scattering are optical phenomena born through the scattering of sunlight in the atmosphere.

Where Rayleigh scattering generates the blue colour of the sky, Mei scattering is the white glow observed around the Sun, when it is high up in the sky. Both types of scattering are a function of particle sizes afloat the atmosphere. Compare both on clear and hazy days, taking good care not to look directly into the Sun.



PHY 518 / EE 538

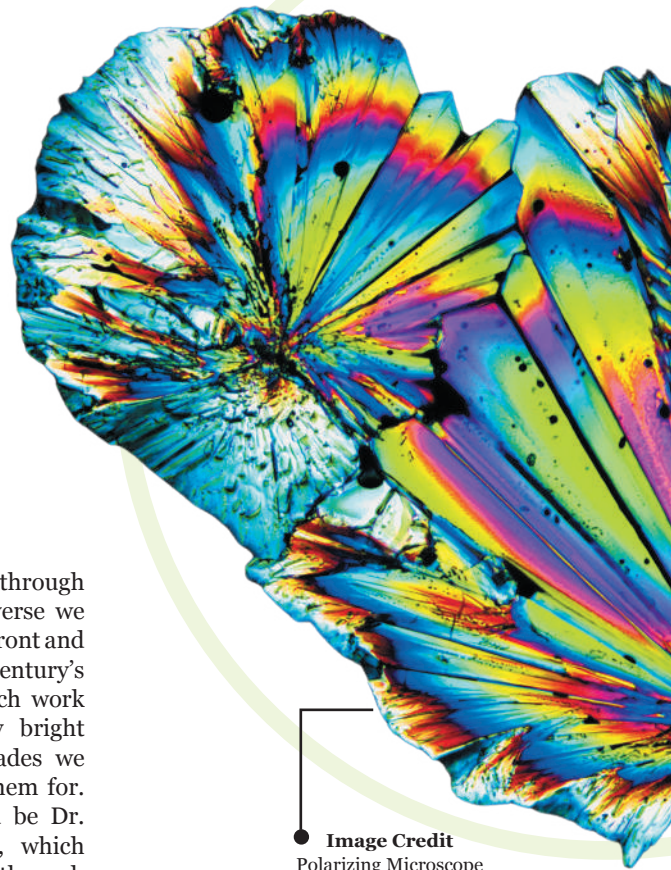
Photonics Fundamentals

By Dr. Tayyab Imran

“

And then, there was light.

A vital component in peering through the deepest secrets of the universe we live in, light has been at the forefront and background of much of 20th century's biggest discoveries. The research work around light has given many bright minds of our times the accolades we have come to know and love them for. A worthy mention here would be Dr. Albert Einstein's Nobel prize, which was awarded for his breakthrough explanation for the photoelectric effect. The keyword here is photonics.

**Image Credit**

Polarizing Microscope
Image Gallery | Science Lab | Leica
Microsystems
(leica-microsystems.com)

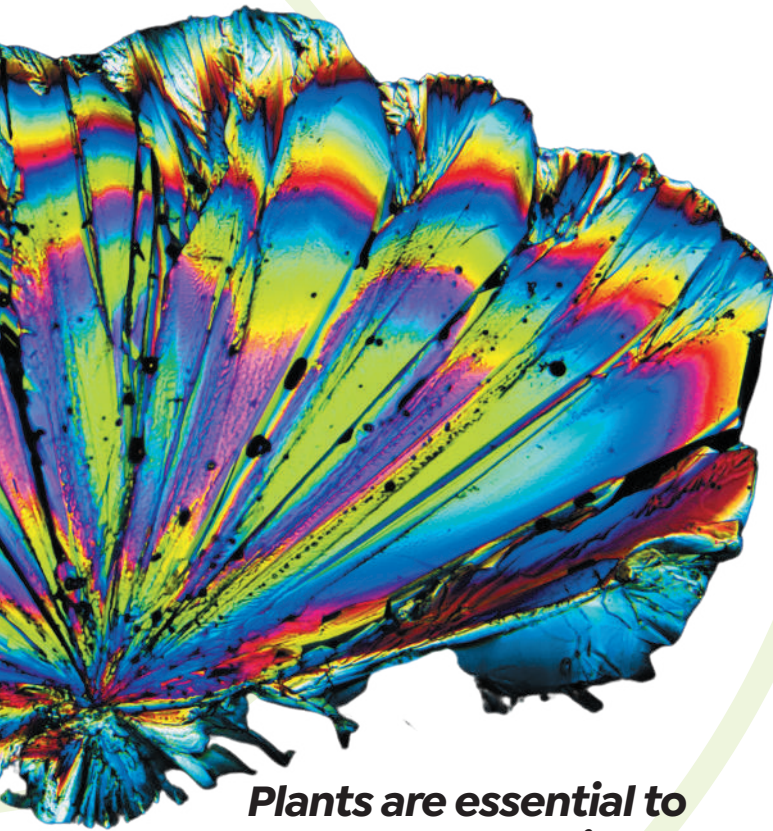
It is a hybrid between physics and engineering and deals with the generation, propagation, manipulation, control, and detection of light within the 'optical' region of the electromagnetic spectrum. This course provides a comprehensive introduction into this important field, from Maxwell's equations to the level of photonic components and building blocks such as lasers, amplifiers, modulators, waveguides, and detectors. This course is divided into two parts: Fundamentals and applications. The fundamentals include Maxwell's equations and wave propagation. The applications include nonlinear optics, electro-optics, and acousto-optics.

This course is offered together by the Department of Physics and Electrical Engineering at SBASSE, LUMS.

BIO 5112

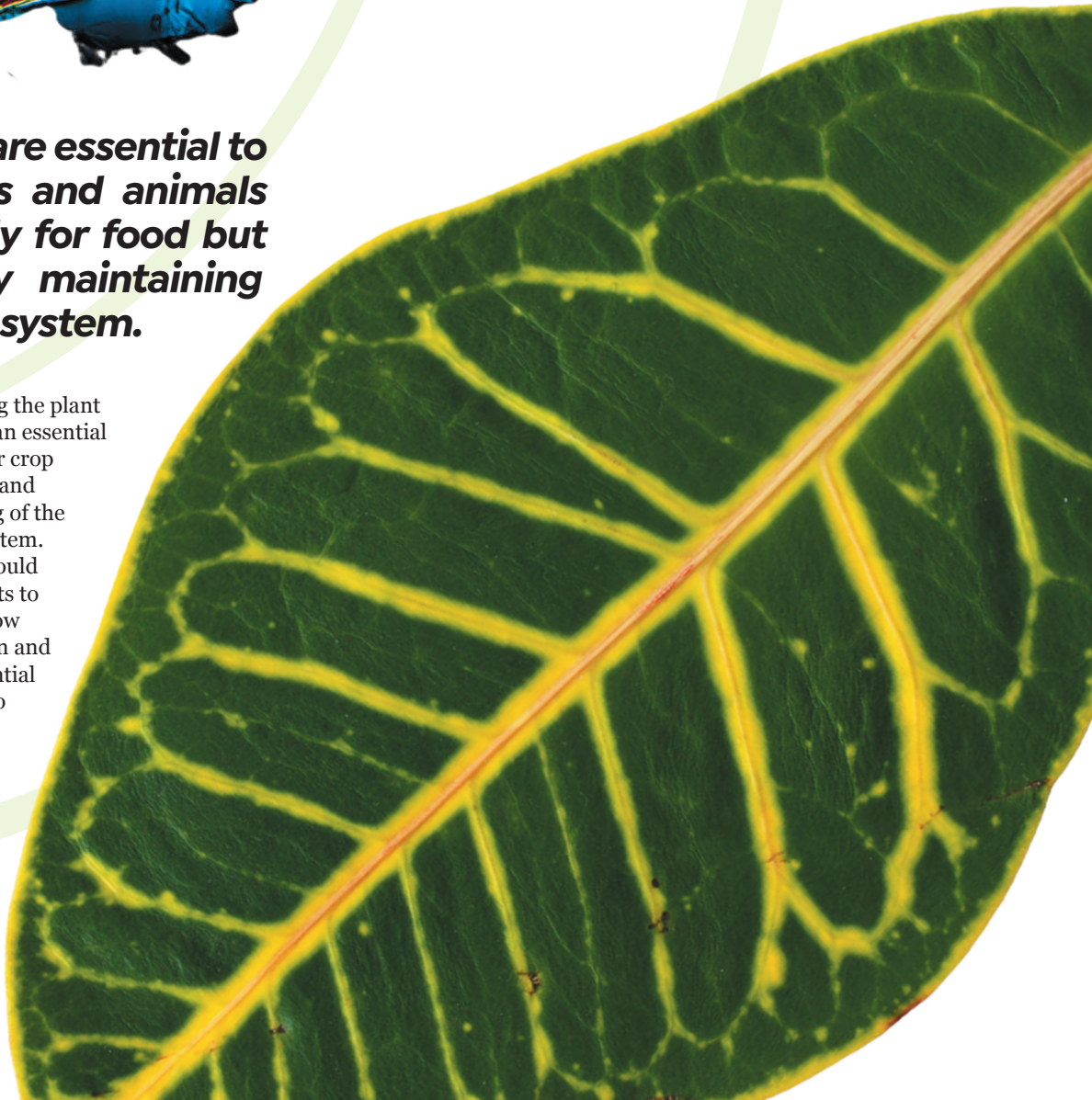
Plant Physiology

By Dr. Khurram Bashir



Plants are essential to humans and animals not only for food but also by maintaining our ecosystem.

Understanding the plant physiology is an essential component for crop improvement and understanding of the world's ecosystem. This course would enable students to understand how plants function and what are essential components to maintain and boost crop production.







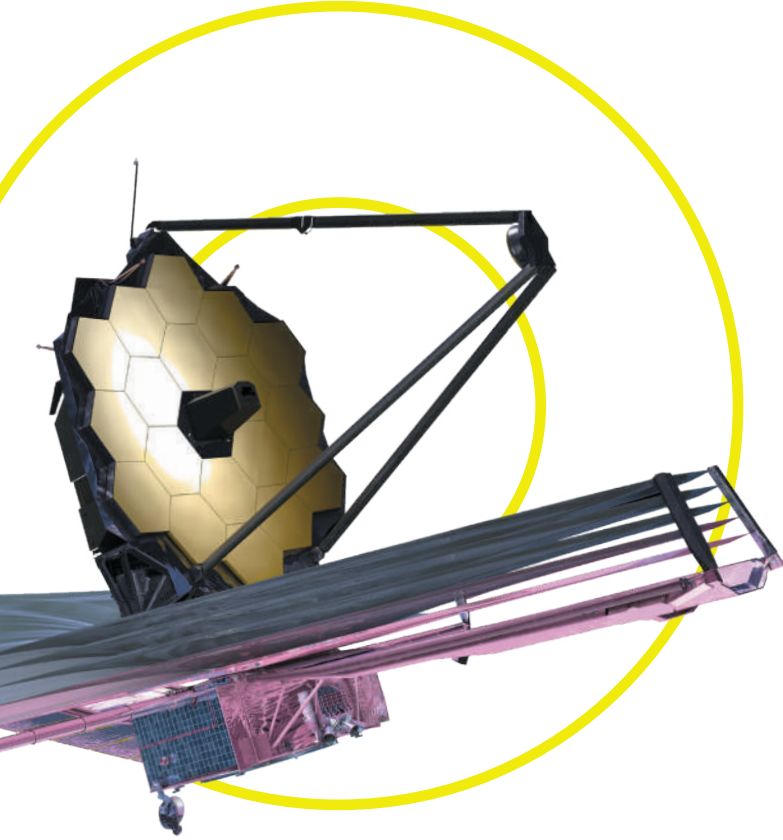
■ Dandelion

Dandelion is native to Europe but found throughout temperate regions in the Northern Hemisphere. From root to flower, dandelions are highly nutritious plants loaded with vitamins, minerals, and fiber.

Image credits

Picture taken at Changa Manga Forest Park by Roshaan Bukhari.

آنکھ کا ارتقا جیمز ویب ٹیلی سکوپ کے لانچ کے موقع پر



پہلے اجداد جو سمندر میں
دھوپ چھاؤں کا فرق جاننے کو
ایک سنسر نسا رکھتے تھے
پھر وہ رنگوں سے آشنائی کو
مرحلہ وار آنکھ تک پہنچے
عد سے جیسی وہ آنکھیں جن سے وہ
ذہن کے پردہ بصارت پر
رنگ و تصویر دیکھ سکتے تھے
اپنے صیاد سے بچاؤ پر
وقت کو زندگی میں بھرتے تھے
لاکھوں سالوں کے اس عمل میں وہ
بینا پرور ہوئے خیالوں سے
اور جب خشکیوں پہ آنکھ لگے
آسمانوں کی سمت تکیں لگے
حرف و تحریر کو پرکھنے لگے
ارتقا کا یہ فن نکھرنا گیا

سلسلہ وسعتوں کا بڑھتا گیا
اور اب ان گنت ستاروں کو
حسن و خوبی کے استعاروں کو
دیکھنے، جاننے کی خواہش ہے
وقت کیا شے ہے، زندگی کیا شے؟
نوع انساں کا کیا مقدر ہے؟
سب فریب نظریا منظر ہے؟
ہم کہ تنہا ہیں کائناتوں میں؟
یا کہ تنہا ہے ہم میں کائنات؟
ڈارک میٹر کہاں پہ بستا ہے؟
وقت کیوں ایک سمت چلتا ہے؟
اس طرح کے کئی سوالوں کو
کھوجنے، جاننے کی خواہش میں
دورینوں کی آنکھ رکھتے ہیں
جو خلاؤں میں مچو گرداں ہیں
جستجو کا سفر تھا تو نہیں
آنکھ کا ارتقا رکا تو نہیں

تعارف

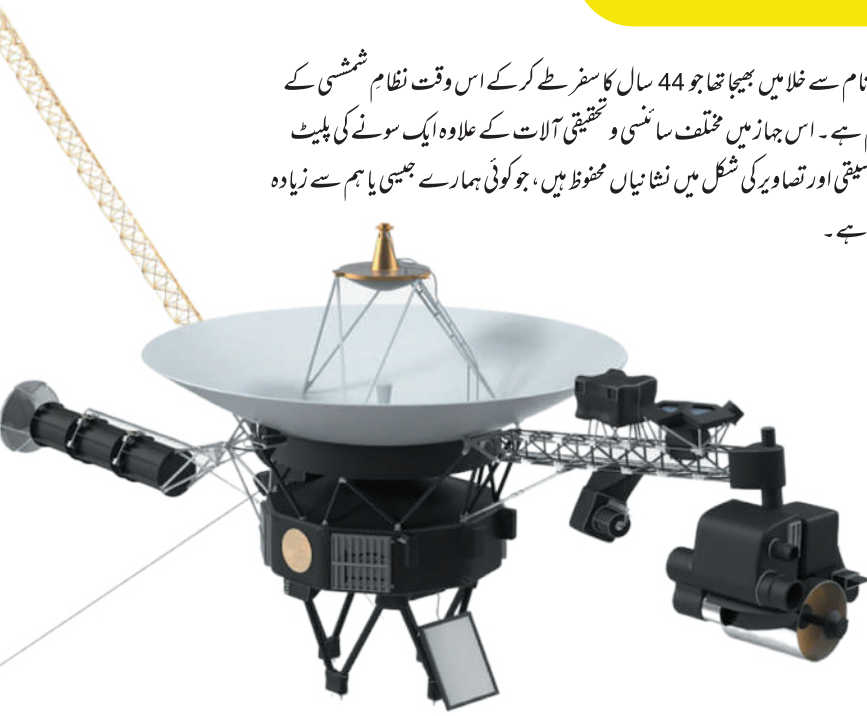
ڈاکٹر حفیظ الحسن فرنچ سپیس ایجنسی کے ساتھ منسلک ہیں جو آجکل پیرس میں ناسا کے مستقبل کے لوز سائنسولوجی پراجیکٹ پر کام کر رہے ہیں جو مستقبل میں چاند پر زلزلے ماپنے کے لئے آلات بنا رہے ہیں۔

انہوں نے فوٹا نکس انجنتیرنگ کے شعبے میں ڈیٹا مارک ٹیکنیکل یونیورسٹی سے پی ایچ ڈی کے ڈگری حاصل کی۔ ماسٹر کی تعلیم جرمنی کی فرڈریک شیلر یونیورسٹی سے حاصل کی۔ جبکہ پاکستان میں غلام اسحاق خان انسٹیٹیوٹ آف انجینئرنگ اینڈ ٹیکنالوجی سے انجینئرنگ سائنس میں پیچلیر زکی تعلیم مکمل کی۔

سائنس کے علاوہ ڈاکٹر حفیظ الحسن کو ادب، تاریخ اور فلسفے کا شوق ہے۔ اسی تناظر میں آج کل یہ اردو شاعری میں سائنسی سوچ و فکر کو زیر موضوع لاتے ہیں۔ انکی سائنسی نظموں پر ایک کتاب جلد ہی شائع ہونے والی ہے۔ بقول انکے اردو شاعری میں جدیدیت تیزی سے ترقی کرتی دنیا کا احاطہ کئے بغیر ناممکن ہے۔

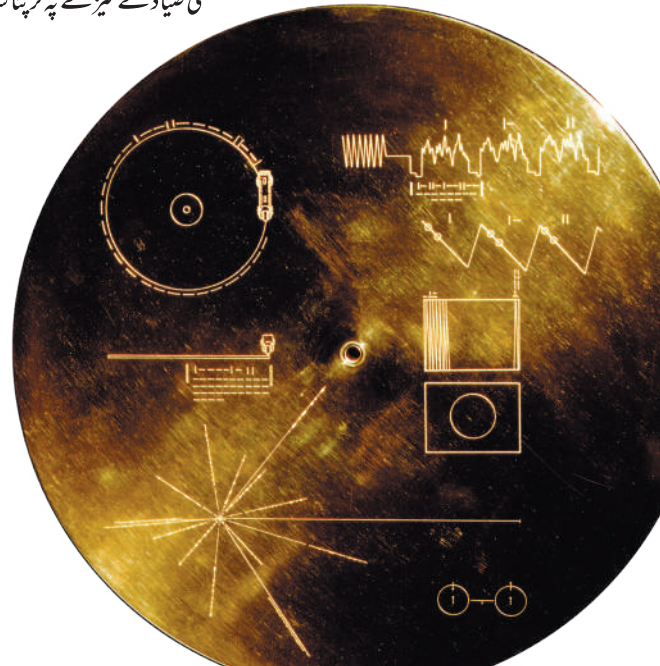
سپیس کرافٹ Voyager 1

1977ء میں ناسا نے ایک سپیس کرافٹ Voyager 1 کے نام سے خلا میں بھیجا تھا جو 44 سال کا سفر طے کر کے اس وقت نظام شمسی کے کناروں تک جا چکا ہے۔ مگر ابھی تک اس کا رابطہ زمین سے قائم ہے۔ اس جہاز میں مختلف سائنسی و تحقیقی آلات کے علاوہ ایک سونے کی پلیٹ بھی رکھی گئی تھی جس میں زمین پر موجود زندگی کے بارے میں موسیقی اور تصاویر کی شکل میں نشانیاں محفوظ ہیں، جو کوئی ہمارے جیسی یا ہم سے زیادہ ذہین مخلوق با آسانی پڑھ سکتی ہیں۔ یہ نظم اُسی تناظر میں لکھی گئی ہے۔



کئی سالوں سے خلاؤں میں بھٹکتا وہ جہاز
جو بنایا تھا زمین زادوں نے
جستجو کے نئے درکھولنے کو
جس میں انسان کے ہونے کا ثبوت
اور خلاؤں میں زمین کا ہے پتہ ملنے کا
اس سیارے پہ بسے لوگ ہیں کون؟
سوچ رکھتے ہیں وہ کیا؟
جانور اور پرندے کیسے؟
نغمہء زیست کے بستے ہوئے ساز
کیمیائت کھلیان، مہکتی ہوئی فصلوں کے حصار
دشت و دریا و ندی، بحر و فلک بوس پہاڑ
کسی بچے کی ہنسی
اور کسی ماں کی ممتا
کسی دہقان کے ہاتھوں سے وہ رستی مٹی
کسی صیاد کے نیزے پہ تڑپتا سا شکار

بیڑی پیتا ہوا ترکی کا وہ بابا جس کے
چہرے پہ وقت نے جھریوں سے بنائے تھے مزار
کسی انسان کی تخلیق کا "فانی" شاہکار
رقص میں ڈوبی ہوئی، ساز پہ بہتی ہوئی نار
ایک سونے کی بڑی پلیٹ میں چسپاں ہیں سبھی
جو خلاؤں میں کئی برسوں سے محو گرداں
ایک اُمید کے مل جائے کوئی اُنکو وہاں
اور پتہ پاکے زمین کا، انہیں ملنے آئے
آکے صدیوں کی اُداسی کا مدوا کر دے
اور تنہائی کا دکھ بانٹے زمین زادوں کا
جن کو رہ رہ کے ستاتا ہے یہ خلوت کا عذاب
پر کہیں ایسا نہ ہو جھیلے تنہائی کا دکھ
خاک ہو جائیں نہ یہ، اُنکو خبر ہونے تک
آہ کو چاہئے اک عمر اثر ہونے تک
کون جیتا ہے تیری زلفت کے سر ہونے تک



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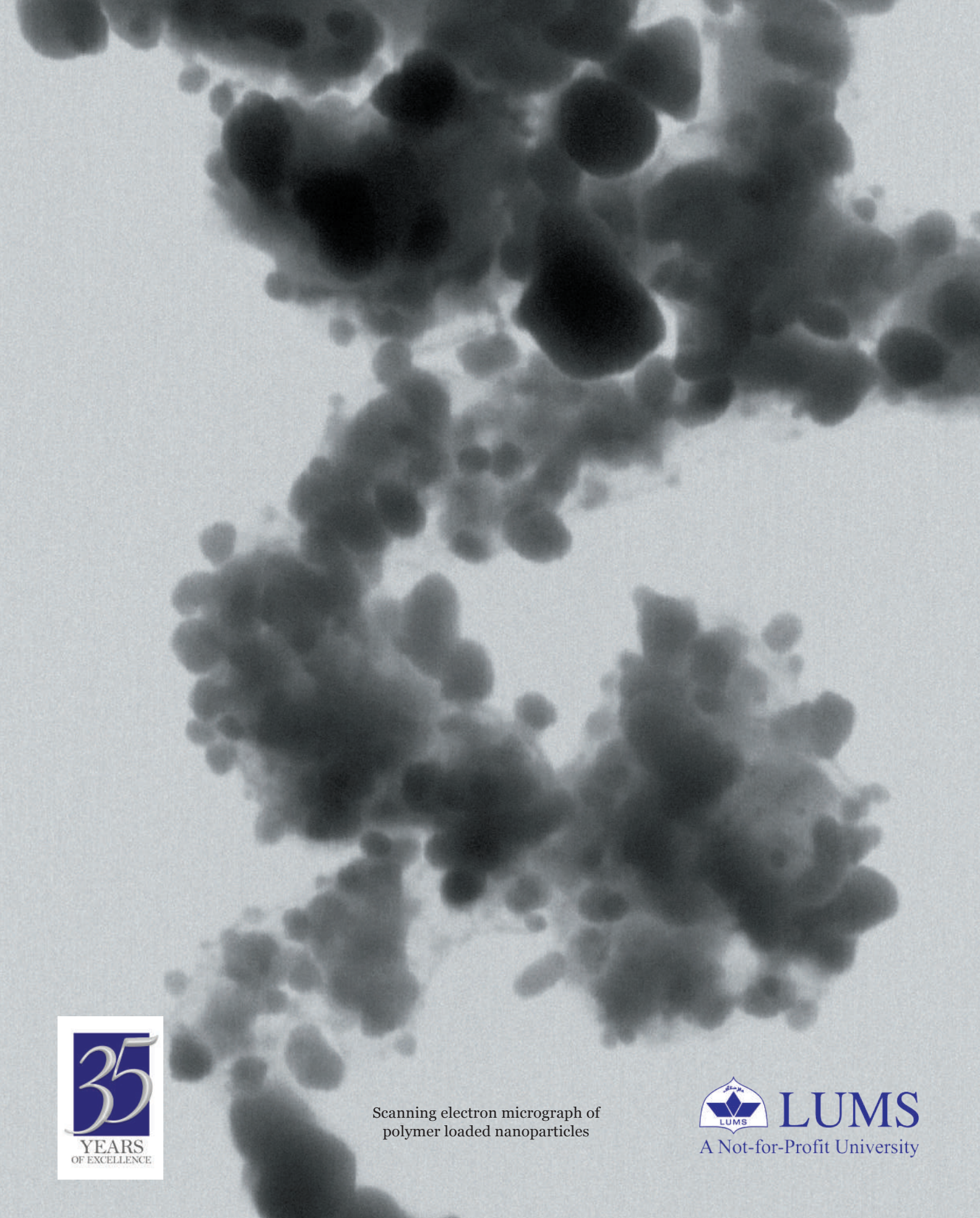
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Scanning electron micrograph of
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