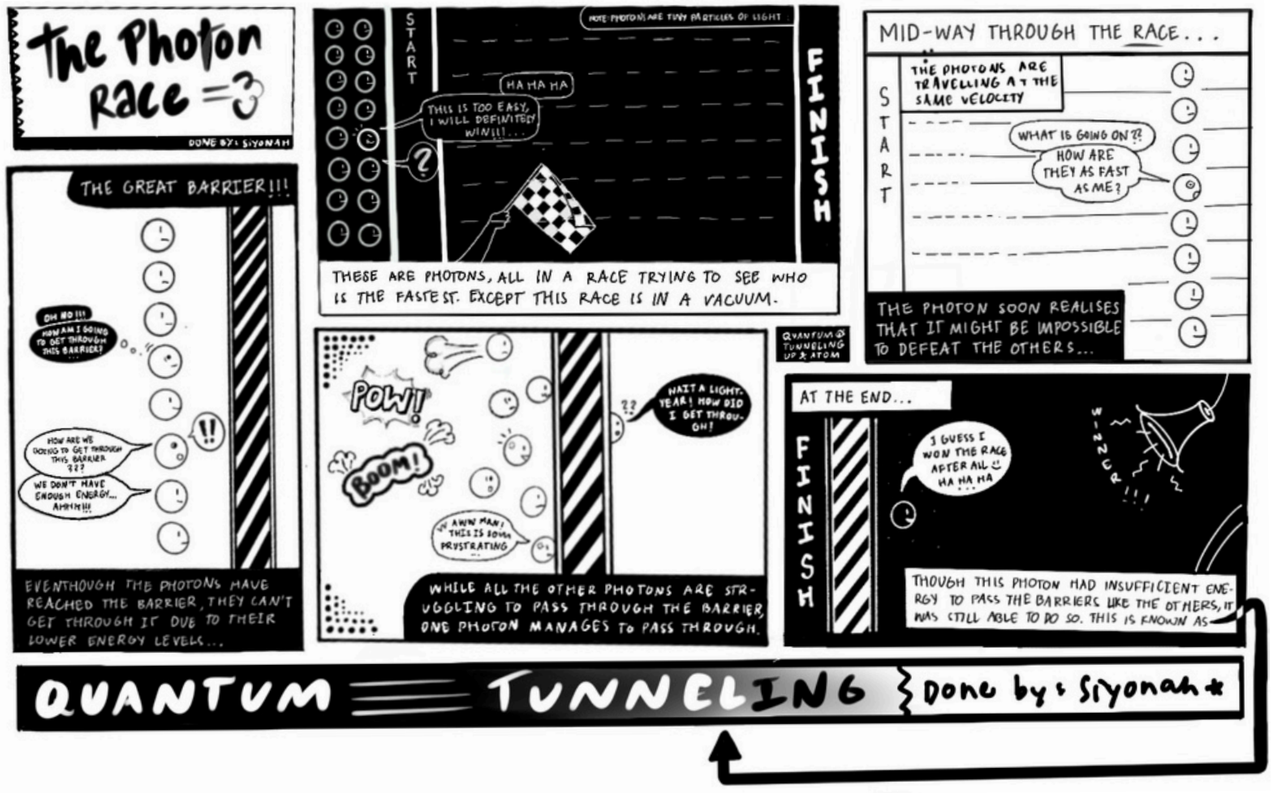
The Science Spectrum

KNOW YOUR ROOTS — AND ATOMS



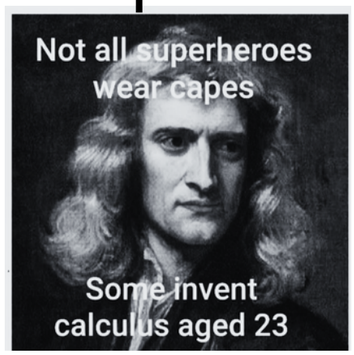
DIY

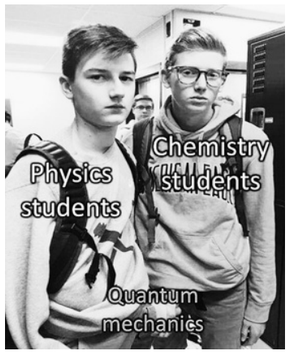
DIY Balloon Rocket:
Materials:
- Balloon
- String
- Drinking straw
- Tape
- Scissors

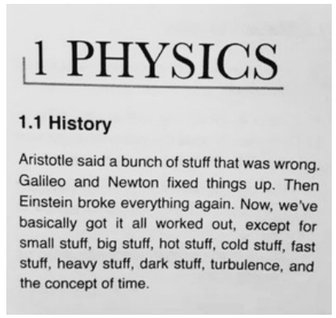
Instructions:
1. Cut a piece of string, about 3-4 feet long.
2. Thread the string through the straw.
3. Tie one end of the string to a stationary object (like a chair or doorknob).
4. Inflate the balloon but don't tie it. Hold the neck of the balloon tightly.
5. Tape the balloon to the straw (make sure the balloon opening is facing the other end of the string).
6. Release the balloon and watch it zoom along the string like a rocket!

Explanation:
When you let go of the balloon, the air rushes out, propelling the balloon forward. This happens because of Newton's third law of motion: for every action, there is an equal and opposite reaction. The escaping air creates a force that pushes the balloon in the opposite direction, causing it to move along the string.

SCI-MEMES







1 PHYSICS

1.1 History

Aristotle said a bunch of stuff that was wrong. Galileo and Newton fixed things up. Then Einstein broke everything again. Now, we've basically got it all worked out, except for small stuff, big stuff, hot stuff, cold stuff, fast stuff, heavy stuff, dark stuff, turbulence, and the concept of time.

CS Academy COIMBATORE

The Science Spectrum

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iSP International Schools Partnership

SEPTEMBER 2024

NOTE TO OUR READERS:

Welcome to the inaugural issue of "The Science Spectrum," our monthly newsletter showcasing the remarkable work of our school students and alumni. Their dedication has shaped this edition to be both engaging and informative for science enthusiasts like you. We hope you enjoy it.

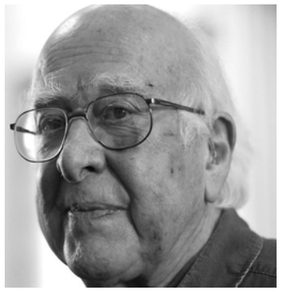
PS: *If you'd like your science contributions featured in our publication, please send them to the email below. We look forward to reviewing them.*
email: **sciencespectrum.newsletter@gmail.com**

DID YOU KNOW?

Sound waves can make bubbles in liquid give off tiny flashes of light? It's called sonoluminescence! When sound waves hit a bubble just right, they create intense pressure changes, causing the bubble to rapidly collapse and release energy in the form of light. It's like a tiny light show happening in a glass of water! The science behind it is still a mystery, though.

FRONTIER FEATURE

DR HIGGS: THE MAN WHO HYPOTHESIZED GOD PARTICLE

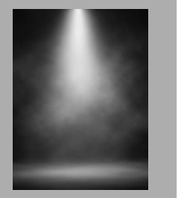


Dr. Peter Higgs, a British theoretical physicist, passed away on April 8, 2024, at the age of 94. He made significant contributions to our understanding of fundamental particles and the forces that shape our universe.

Dr. Higgs's most famous work involved the theoretical proposal of a field, now known as the Higgs field, and a particle associated with it, the Higgs boson, the god particle. The existence of the Higgs boson was confirmed by experiments at the Large Hadron Collider (LHC) at CERN in 2012. This discovery helped solidify our understanding of how particles acquire mass.

Dr. Higgs's work has had a profound impact on physics, and his legacy will continue to inspire future generations of scientists.

DOUBLE FACE OF LIGHT



Light. It allows us to see the world around us. But how does it actually travel? Classically, when light was thought of as like the water waves, in the modern world (since the early 20th century), the understanding of it has changed vastly. It turns out light is made of small particles, packed with a certain amount of energy, called photons. These particles vibrate according to their energy. When measuring the light properties, they exist as particles at one instant of time and as waves in another instant. This property of light being both particle and waves is called the wave-particle duality. Interestingly, it is not just light, but anything in the universe would be vibrating and will have frequency, but the key is that as bigger the structure gets, the lesser the vibrations become, so in your case, it becomes very negligibly small.

Therefore, you, or any objects at macro level, unlike photons like small particles (described as point particles), do not have significant vibrations. Macro objects can be approximated and work well with the classical physics you know and understand, but photons, electrons, and other smaller particle's wave properties are significant enough that they could be understood up to an extent with quantum mechanics.

MASS: THE ORIGIN

Charge is so far considered to be an intrinsic property of the smallest known particles, and they exist in discrete amounts. What about mass? In macro scale, mass is considered to be a measure of inertia-- the ability of an object to resist motion. When zooming further into the fundamental level, is mass an intrinsic property of a fundamental particle? Well quite not. The mass is acquired by a particle when moving in and interacting with the experimentally proven field called the Higgs field, which is spread throughout the entire universe.

Well how does it acquire mass exactly? Well think of your friend and yourself being in a ball pit, where the whole area is covered with balls. You are more enthusiastically ready play and interact with the balls, while your friend is not quite interested as you to spend time in the ball pit. Now, the ball pit is the universe, the balls are collectively, the Higgs Field, and you both are fundamental particles, each with DIFFERENT PROPERTIES. Your interests can be thought of a property called Yukawa coupling strengths, which decides the particles ability to interact with the Higgs field.

In conclusion, mass is not an intrinsic property of a particle but it is acquired by the particle due to the interaction with Higgs Field, and the interaction depends on the Yukawa coupling strength.

- Dev Darshan
A2 Level

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Neuroplasticity: Your Brain's Hidden Superpower

Neuroplasticity is like a hidden superpower of the brain—a fascinating ability that lets it change and adapt in response to experiences and injuries. It's kind of like the brain's way of being flexible and resilient, just like a superhero adjusting to different challenges.

Let's dive into the science behind it: Inside your brain, there are billions of nerve cells called neurons. When you learn something new, like mastering a new video game or picking up a new hobby, these neurons form connections with each other. These connections are called synapses, and they're like the bridges that allow information to travel between neurons.

Think of it this way: when you practice a new skill, like playing a musical instrument or shooting hoops on the basketball court, your brain strengthens the connections between the neurons involved in that activity. This process, known as synaptic plasticity, is what allows you to get better at the skill over time. It's like building a stronger bridge between two islands so that information can flow more smoothly.

But here's the really cool part—neuroplasticity isn't just about learning new things. It's also crucial for recovery after injuries. Imagine you get a concussion while playing sports. Your brain can actually reorganize itself to compensate for the damage, kind of like rerouting traffic around a construction site. This ability to adapt and rewire itself is what enables you to recover and get back to your normal activities.

Rehabilitation techniques, like physical therapy and cognitive exercises, take advantage of neuroplasticity to help speed up the recovery process after brain injuries. These techniques encourage the brain to form new connections and pathways, facilitating healing and restoring lost functions.

In essence, neuroplasticity demonstrates the incredible adaptability of the brain. It's a reminder that our brains are not fixed entities but dynamic and malleable structures capable of change. Understanding how neuroplasticity works not only deepens our appreciation for the complexity of the brain but also offers hope for individuals facing neurological challenges.

So, the next time you're struggling to learn a new concept or facing a setback, remember the power of neuroplasticity. With a little practice and perseverance, your brain can overcome obstacles and achieve remarkable feats!

-Parth - CS Alumnus
Current institution: NMIMS, Mumbai

MONTHLY SPOTLIGHT

1)Researchers at Baylor College of Medicine identified new cancer therapeutic targets by integrating proteomics, genomics, and epigenomics data from 10 cancer types. They expanded the list of potential targets and validated them experimentally, offering new avenues for drug development and treatment strategies.

2)Researchers at the University of Copenhagen have developed a bio-composite material from barley starch and sugarbeet waste fibers. This eco-friendly material is strong, decomposes in nature within two months, and could replace traditional plastics in packaging and other applications. They aim to combat plastic pollution and reduce the climate impact of plastic production.

A wonder-drug for the sleep-deprived: The Science Behind Energy Drinks

We've all been there - it's the night before the deadline of a big assignment, and you need to pull an all-nighter to get it done with. While you're ready to put the work in, your body isn't - after a long day, it really wants some sleep, which is understandable. Regardless, you go for the obvious solution - you open up and chug a can of your preferred energy drinks, and begin powering through. But, have you ever stopped to wonder how these energy drinks actually provide you energy?

"Well, of course I have - it's caffeine!" I could hear you all collectively scream to that question. But, that doesn't really answer the deeper question of how caffeine works to begin with. To answer that question, we have to first understand how the sensation of sleepiness works.

When you wake up and go about your day, your brain starts releasing a neurotransmitter called adenosine. The amount produced depends on multiple factors, such as physical activity and food consumption - but generally, it keeps getting generated as your day progresses. This adenosine travels to and occupies adenosine receptors, which is what causes the feeling of sleepiness. The more receptors occupied, the sleepier you'll feel.

Now, caffeine works in quite an ingenious way to circumvent this natural process. You see, the physical shape of caffeine is very similar to that of adenosine. Hence, when consumed, caffeine travels to the brain, where it fills up the adenosine receptors, thereby not allowing actual adenosine to occupy them. This results in a lack of a sensation of sleepiness. But of course, the caffeine can only occupy the receptors for so long, and once they leave, the adenosine built up in the process rushes to occupy the receptors - this is why caffeine leads to drowsiness in the long term.

But, the keen-eyed among everyone of you would've noticed that caffeine is usually not the only headlined ingredient advertised in these energy drinks - other common ingredient buzzwords include taurine, inositol and B Vitamins. The thing is, the effects of these chemicals are far more questionable; the thing is, it has been shown that these chemicals could lead to neural stimulation, mitochondrial activation (powerhouse of the cell, remember), electrolyte modulation and insulin control, which could conceivably also contribute to the "energy" part of the energy drink. But, at the level of dosage that these drinks have, most sources say that these chemicals are unlikely to cause major energy gains.

At the end of the day, you could actually also just attribute the energy to the massive amount of sugar in these drinks, the strong, fizzy taste that these drinks tend to have, and the placebo effect of consciously consuming a drink that is labelled as an "energy drink". But that's no fun, is it!

-Arya - CS Alumnus
Current institution: University of Toronto, Canada

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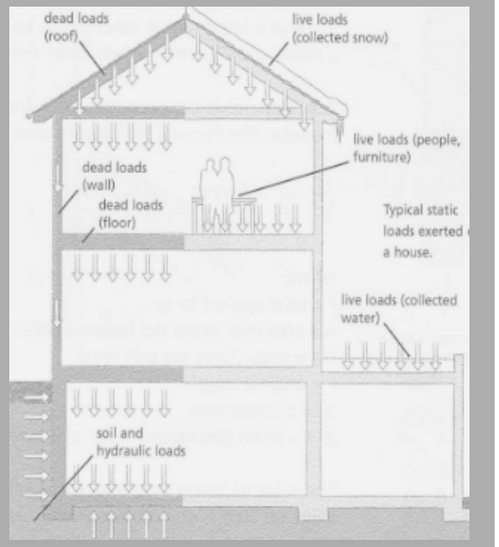
Unveiling the Physics Behind the Structures

In this edition, we dive into the fantastical harmony of architecture and physics, uncovering the hidden forces that shape our built environment.
From towering skyscrapers to gigantic bridges, every architectural wonder is a testament to the principles of physics in design. Architects seek to challenge existing norms of form and space and continue exploring new horizons. A pre-existing knowledge of physics contributes towards an integrated approach, accounting for experimental and technical aspects of design and construction.



Understanding the principles of physics on a built structure :

Physics in architecture is used in practical problem-solving, to ensure that a structure stands erect. Certain physics principles are considered in designing such a structure:

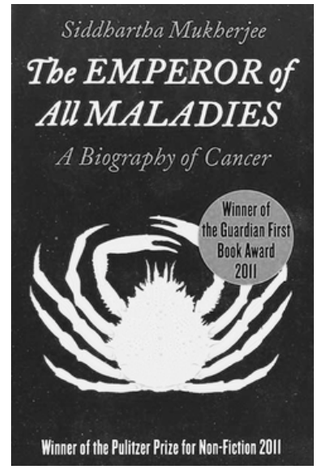
1. Structural Engineering: Understanding the basics of how structures withstand various forces.
2. Environmental Physics: Knowledge of light, heat and acoustics (eg: how light interacts with different materials and surfaces, to design a building with optimal natural lighting.
3. Material Sciences: Understanding the properties of different materials to accommodate for expansion and contraction due to changing temperatures, or how they can withstand loads.
4. Sustainability and Energy Efficiency: Knowledge of thermodynamics to improve energy efficiency and sustainability, particularly in today's environmentally conscious world.

As we peel back the layers of these architectural feats, we gain a deeper appreciation for the intricate dance between form and function. Follow along as we unravel the mysteries of architecture through the lens of physics.

-Sruthi - CS Alumnus
Current Institution: UNSW, Australia

Read and Review:

Emperor of All Maladies by Sidhartha Mukherjee



"Emperor of All Maladies" by Siddhartha Mukherjee is a compelling narrative that delves into the history, science, and human experience of cancer. Mukherjee masterfully intertwines personal stories of patients battling cancer with the scientific discoveries and medical breakthroughs that have shaped our understanding of the disease. Through meticulous research and vivid storytelling, Mukherjee provides a comprehensive overview of the war against cancer, from its earliest documented cases to modern-day treatments. He navigates through the complexities of cancer biology, the challenges of diagnosis and treatment, and the ethical dilemmas faced by patients and physicians alike. What sets "Emperor of All Maladies" apart is its ability to humanize the disease, presenting it not just as a medical phenomenon but as a deeply personal and emotional journey for those affected by it. Mukherjee's prose is both accessible and engaging, making this book a must-read for anyone interested in the history of medicine, the intricacies of cancer research, or simply the triumph of the human spirit in the face of adversity.

-Swati
A2 Level