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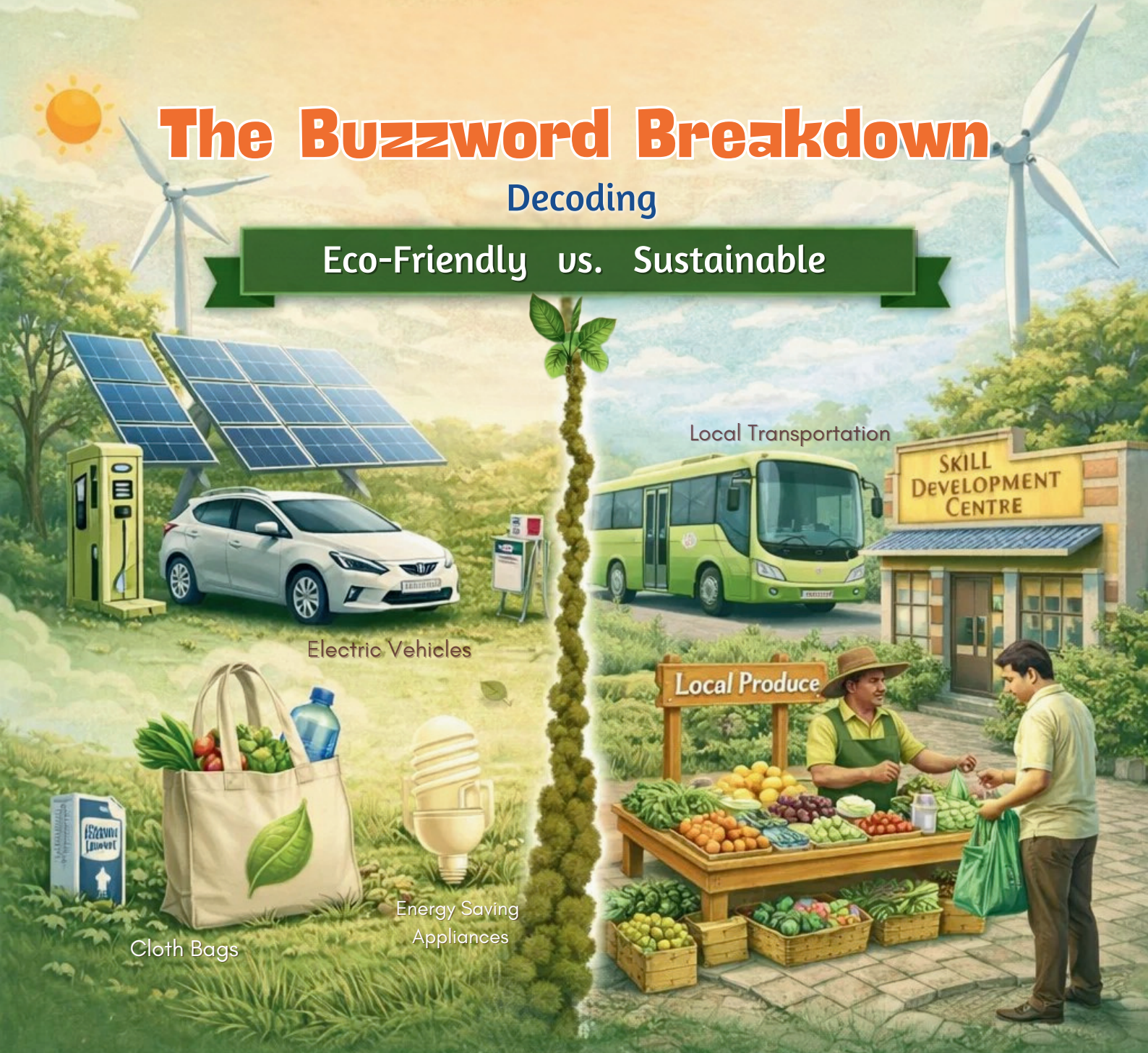
Young Scientist India

A Science & Innovation Magazine for Curious Teachers

The Buzzword Breakdown

Decoding

Eco-Friendly vs. Sustainable



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JAGADISH CHANDRA BOSE
SRINIVASA RAMANUJAN
MEGHNAD SAHA

PRIORITIZATION TECHNIQUES
DECISION MATRIX ANALYSIS
CONCEPT OF THE ATOM
FIBONACCI NUMBERS

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From the Editor's Desk

Welcome, Young Scientists!

Greetings to our bright, curious, and ever-questioning reader. As we step into the January issue and a new year, we are grateful to share that Young Scientist India has successfully **completed one full year of publication**. We sincerely thank our readers, contributors, and supporters for their encouragement, and we look forward to bringing you even more exciting articles in the year ahead.

Our Cover Story, **The Buzzword Breakdown**, helps us understand many of the popular terms we often hear today in the world of science, technology, and innovation. By breaking down buzzwords like artificial intelligence, sustainability, and blockchain, we hope to help young learners understand them clearly and use them thoughtfully in their learning journey.

Innovation also depends on the ability to think clearly and make informed decisions. In this edition's Innovation Training Modules, we introduce **Prioritization Techniques** and **Decision Matrix Analysis**—two practical tools widely used by innovators, scientists, and problem-solvers.

Our Articles section connects science to everyday life. In **AI in Everyday Life**, we explore how artificial intelligence powers many of the tools and applications we use daily. **Magnets to Build Electric Motors** shows how the simple force of magnetism can create motion and power machines that drive modern technology. In **How Sensors Work**, we uncover the science behind smart devices that detect light, motion, temperature, and other changes in the environment.

India's scientific heritage is both rich and inspiring. In **Indian Inventions & Innovations**, we explore fascinating ideas such as the Boson Particle, the Concept of the Atom, the Bhatnagar-Mathur Magnetic Interference Balance, and the mathematical beauty of Fibonacci Numbers. These topics remind us that scientific discovery often begins with curiosity about how nature works.

We also celebrate the contributions of inspiring Indian scientists such as Vikram Sarabhai, Jagadish Chandra Bose, Srinivasa Ramanujan, and Meghnad Saha, whose work continues to influence science today. This issue also highlights leading research institutions including the Regional Science Centre Arunachal Pradesh, CSIR-CMERI, CRRI, and CSIO, which play a key role in advancing innovation in India.

In our Innovations for Inspiration section, we showcase creative ideas like MediBridge, R-Brush, UV Dry Boost, and Jeevan Rakshak, demonstrating how young innovators are solving real-world challenges.

Stay curious, keep experimenting, and remember—every great discovery begins with a simple question.

Happy learning!

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S&I Article

AI in Everyday Life

How Students Can Build Smart Tools

Artificial Intelligence (AI) is no longer science fiction. It recommends the videos you watch, corrects your grammar, unlocks your phone with face recognition, and even suggests the fastest route home. From voice assistants to smart traffic systems, AI quietly works behind the scenes in everyday life.

But here is the exciting part: students don't have to just *use* AI — they can *build* with it.

What Is AI, Really?

Artificial Intelligence refers to machines or software that can perform tasks that usually require human intelligence — like recognizing images, understanding speech, learning from data, or making decisions.

When you use translation tools, chatbots, or music recommendation apps, you are interacting with AI systems trained on large amounts of data.

Globally, companies like Google, Microsoft, and OpenAI develop AI tools that power search engines, productivity software, and conversational assistants. But you don't need a big lab to start building your own smart tools.

AI Around You

Here are a few everyday examples students can easily observe:

- Smart keyboards that predict the next word
- Face recognition on phones
- Spam filters in email
- Recommendation systems on shopping apps
- Navigation apps that avoid traffic

How Students Can Build Smart Tools

You don't need advanced degrees to begin. You need curiosity and experimentation.

1. Start with Problem - Solving

- Look around your school or community.
- Is attendance tracking slow?
- Is waste segregation poorly managed?
- Do students struggle with revision planning?

AI works best when it solves a real problem.

2. Use Beginner-Friendly Platforms

There are free tools that allow students to experiment with AI without heavy coding:

- Scratch with AI extensions
- Teachable Machine by Google
- Basic Python libraries like TensorFlow or Scikit-learn
- Simple chatbot builders

With these tools, students can:

- Build a model that identifies recyclable vs. non-recyclable waste

- Create a chatbot that answers school FAQs
- Develop a study planner that suggests revision schedules
- Design a mood-check assistant for student wellbeing

3. Combine AI with Hardware

AI becomes even more exciting when combined with robotics and electronics. Using platforms like Arduino or Raspberry Pi, students can build:

- Smart plant-watering systems
- Obstacle-avoiding robots
- Automated energy-saving lights
- AI-powered weather alerts

This blends coding with engineering — a powerful skill combination.

Think Ethically

While building AI tools, students must ask important questions:

- Is the data being used responsibly?
- Is privacy protected?
- Could the tool unintentionally harm someone?
- Is the system fair and unbiased?

AI is powerful, and with power comes responsibility.

The Future Belongs to Builders

India is rapidly becoming a global technology hub. With initiatives promoting coding and digital literacy, today's students are tomorrow's innovators.

You don't need to invent the next global platform. Start small. Build a tool that helps your classroom. Improve it. Learn from mistakes. Experiment again.

AI is not just about machines becoming smarter.

It is about students becoming smarter problem-solvers.

And the best time to start building is now.

Sudoku Challenge 2601

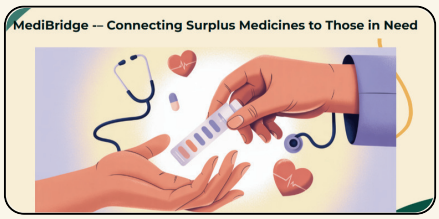
		2	7	8				3
					9	8		1
4					3		7	
9		5			8			
				7				
			5			4		8
	6		4					7
3		9	8					
8				3	1	6		

(Answers on Back Cover Inside)

MediBridge

Yogesh Prasad
9th Class

Every year, millions of perfectly usable medicines are discarded due to expiry concerns, over-purchasing, or incomplete prescriptions. At the same time, many low-income families struggle to afford essential medicines. This imbalance not only deepens healthcare inequality but also creates environmental hazards, as improper disposal of medicines can contaminate soil and water. The absence of a centralised, reliable system to collect and redistribute surplus medicines makes the problem even more severe. Recognising this gap between excess and need, the project proposes a sustainable and technology-based intervention.



MediBridge is a digital platform designed to safely collect, verify, and redistribute unused medicines to underprivileged communities. Through a user-friendly web portal, donors can upload details of available medicines.

The system then performs verification checks and uses smart matching algorithms to connect supplies with verified recipients based on demand. Real-time tracking and notifications ensure transparency and accountability throughout the process. By reducing medicine wastage, improving access to essential drugs, and encouraging responsible consumption, MediBridge creates a bridge between surplus resources and communities in need, promoting both healthcare equity and environmental responsibility.

(Source: GYS Avishkar Awards 2025 Booklet)

Link for the project's video presentation
YouTube.com/@GETAYoungScientist

Harvesting Energy From Human Movement

Shubham Garg
11th Class

As cities grow busier and energy demands increase, finding sustainable power sources has become essential. This project explores piezoelectricity - a phenomenon where certain materials generate electricity when mechanical pressure is applied. Every time we walk, our footsteps create pressure on the ground. In piezoelectric materials, this pressure produces an electric charge. Although a single step generates only a tiny amount of power — enough to briefly light a small LED — the collective impact of thousands of footsteps in crowded areas holds significant potential.

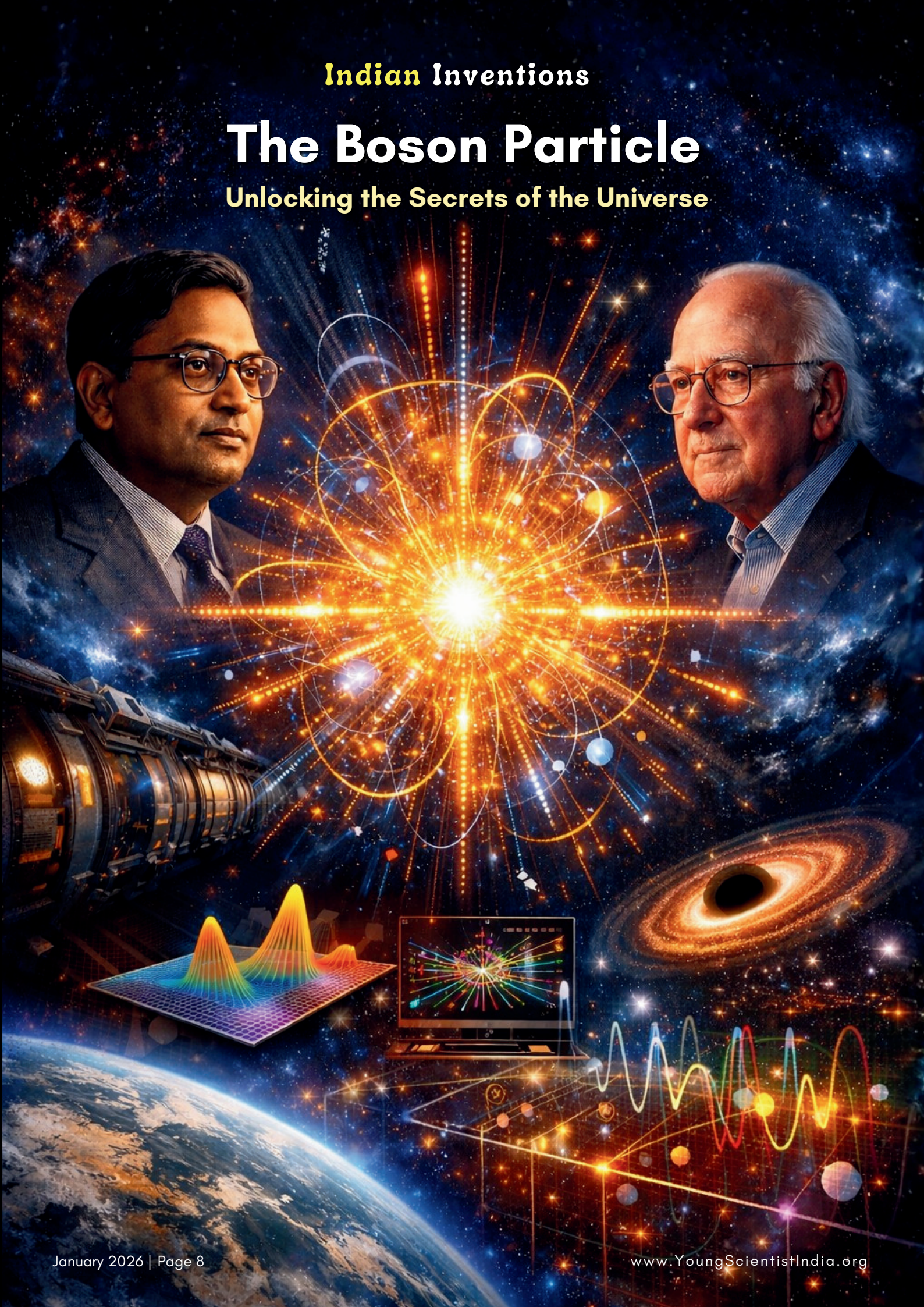
The proposed solution is the installation of "Piezets" — piezoelectric flooring systems placed in high-footfall locations such as railway stations, malls, and concert venues. When people walk across these floors, embedded sensors capture the pressure and convert it into electrical energy. The energy is then rectified into usable direct current and stored for later use. While one step produces minimal electricity, around 28,500 steps together could generate enough power to move a train. By converting everyday movement into renewable energy, this idea transforms ordinary footsteps into a smart and sustainable power source.

(Source: INSPIRE MANAK NLEPC 2012 Booklet)

Indian Inventions

The Boson Particle

Unlocking the Secrets of the Universe



Some innovations do not change how we live day to day but they change how we understand reality itself. The Boson particle belongs to this rare category. It represents one of humanity's deepest scientific achievements and has a powerful Indian connection at its core. From abstract mathematics to massive underground machines, the story of bosons is a story of curiosity, patience, and pure science.

What Is a Boson Particle?

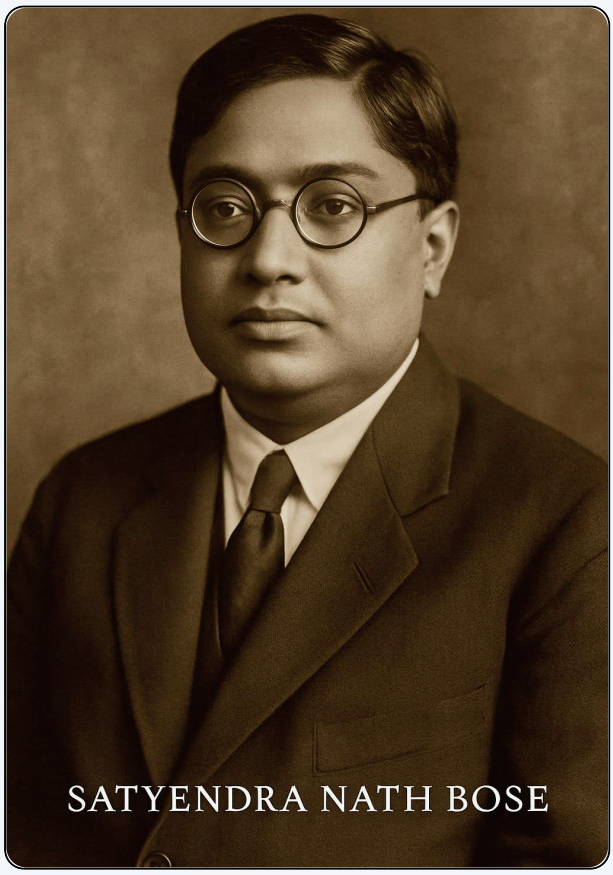
In physics, particles are broadly divided into two groups: fermions and bosons. Fermions make up matter electrons, protons, and neutrons. Bosons, on the other hand, are particles that carry forces and enable interactions between matter.

Bosons are essential to how the universe works. Without them, particles would not attract, repel, or even have mass. Some well-known bosons include photons (light particles) and gluons (which hold atomic nuclei together). Among all bosons, one stands out for its importance the Higgs boson.

The Indian Connection: Satyendra Nath Bose

The very word boson comes from Satyendra Nath Bose, a brilliant Indian physicist. In the 1920s, Bose developed a new way to understand how particles behave at the quantum level. His work was so revolutionary that Albert Einstein extended it further, leading to what is now known as Bose – Einstein statistics.

In honour of Bose's contribution, this entire class of particles was named bosons. This makes bosons one of the most globally recognised scientific concepts named after an Indian scientist, an immense point of pride for Indian innovation and thought.



The Higgs Boson: Why It Matters

The Higgs boson is often called the "God Particle," though scientists prefer its formal name. Its importance lies in one key question:

Why do particles have mass?

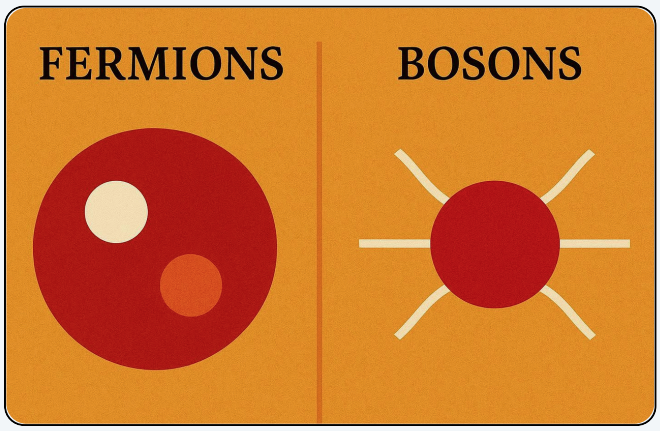
According to modern physics, particles gain mass by interacting with an invisible energy field called the Higgs field. The Higgs boson is evidence that this field exists. Without it, atoms would not form, stars would not exist, and life would be impossible.

In simple terms, the Higgs boson helps explain why anything has weight or substance at all.

A Global Scientific Achievement

The Higgs boson was not discovered easily. It took decades of theoretical work and one of the most complex machines ever built the Large Hadron Collider (LHC) at CERN in Switzerland.

In 2012, scientists announced the successful detection of the Higgs boson, confirming predictions made nearly 50 years earlier. This discovery involved thousands of scientists from around the world, including significant contributions from Indian researchers and institutions.



Why the Boson Is an Innovation

The discovery of the boson particle is innovative for several reasons:

- **Pure curiosity-driven science:** No immediate commercial use, just the desire to understand the universe
- **Advanced technology:** Required superconducting magnets, extreme temperatures, and near light-speed collisions
- **Global collaboration:** Scientists from over 100 countries worked together
- **Indian intellectual roots:** Named after an Indian physicist whose ideas reshaped quantum theory

It shows that innovation is not always about products, it can be about ideas that redefine knowledge.

Impact Beyond the Laboratory

While bosons may seem distant from everyday life, their study has led to real - world benefits:

- Development of advanced medical imaging technologies
- Improvements in computing and data analysis
- Progress in materials science and electronics
- Training generations of scientists and engineers

Large scientific experiments also push the limits of engineering, software, and problem - solving skills that later benefit society in unexpected ways.

Why This Matters for Students

The story of the boson particle carries powerful lessons for young learners:

- Big discoveries often start with simple questions
- Theory and imagination are as important as experiments
- Indian thinkers have shaped global science
- Not all innovations are immediate some take decades

Students can learn that science is a long journey, where patience and curiosity matter more than quick results.

A Quiet Giant of Human Knowledge

The boson particle may be invisible to the eye, but its impact is enormous. From Satyendra Nath Bose's equations written in India to experiments deep underground in Europe, the boson represents humanity's shared quest to understand existence.

It reminds us that Indian innovation is not limited to tools or technologies, it also lives in ideas that help decode the universe itself.

Indian Scientist

Dr. Vikram Sarabhai

Architect of India's Scientific Future

(12 August 1919 - 30 December 1971)

In 1962, when India was still a young and developing nation, Dr. Vikram Sarabhai laid the foundation for what would become the Indian Space Research Organization (ISRO). At a time when the country faced poverty and limited resources, his decision to invest in space research seemed bold - even unrealistic to many.

But Sarabhai was not chasing prestige. He was pursuing purpose.

He believed space technology could directly improve life on Earth. Satellites, he said, could strengthen communication in remote villages, improve weather forecasting for farmers, and expand educational access across the country. For him, innovation was meaningful only if it served society.

Sarabhai also helped build institutions such as the Physical Research Laboratory and the Indian Institute of Management Ahmedabad. He understood that strong institutions nurture future innovators.

What makes his story powerful is not just what he built, but how he thought - boldly, responsibly, and with long-term vision.

Classroom Reflection Activity

Invite students to imagine they are leading a "Space for Society" mission today.

Ask them:

- What local problem would you solve using technology? (water scarcity, waste management, disaster alerts, rural education?)
- Who would benefit from your solution?
- How would you ensure it serves people ethically and responsibly?

Students can present their ideas as a short proposal, poster, or group discussion.

Through this exercise, they begin to understand Sarabhai's core belief: innovation is not about building impressive machines - it is about improving human lives.

Vikram Sarabhai did not just launch rockets.
He launched a way of thinking that continues to shape India's future.

Cover Story

The Buzzword Breakdown

Decoding Eco-Friendly vs. Sustainable

Walk into any supermarket, scroll through social media, or listen to a school debate, and you will hear the words *eco-friendly* and sustainable everywhere. From eco-friendly water bottles to sustainable fashion brands, these terms have become part of everyday language. But do they mean the same thing? Or are we using them without fully understanding what they truly represent?

In this edition of **Young Scientist Magazine**, we break down these buzzwords so that you – the young innovators and future decision-makers – can think clearly, question wisely, and act responsibly.

What Does "Eco-Friendly" Really Mean?

The word eco-friendly literally means "friendly to the environment." It refers to products, actions, or practices that do not harm nature.

For example:

- A reusable cloth bag instead of a plastic one
- A biodegradable toothbrush made of bamboo
- Solar-powered streetlights
- Natural cleaning products without harmful chemicals

An eco-friendly choice usually focuses on reducing pollution, saving energy, or preventing waste. It asks a simple question: *Does this harm the environment?* If the answer is "no" or "very little," it may be considered eco-friendly.

However, eco-friendly often focuses on a **single stage** - usually the end product. It does not always look at the full journey of how something was made.

What Does "Sustainable" Mean?

Sustainable is a broader and deeper concept. It means meeting our needs today **without compromising the ability of future generations to meet their needs.**

This idea became globally recognized after the 1987 report by the World Commission on Environment and Development, often called the Brundtland Commission.

Sustainability looks at three major pillars:

1. **Environmental Sustainability** – Protecting natural resources
2. **Social Sustainability** – Ensuring fairness, health, and equality
3. **Economic Sustainability** – Supporting livelihoods and long-term prosperity

For example, a sustainable clothing brand would:

- Use organic or recycled materials
- Ensure workers are paid fairly
- Minimize water and energy use
- Design clothes that last longer

Sustainability asks a bigger question:

Can this system continue for decades without damaging the planet or society?

Eco-Friendly vs. Sustainable: Spot the Difference

Here is a simple way to understand it:

Eco-Friendly	Sustainable
Focuses mainly on reducing environmental harm	Focuses on long-term balance between environment, society, and economy
Often product-based	Often system-based
Short-term impact	Long-term impact
"Is this good for nature?"	"Will this work for future generations?"

Think of eco-friendly as a step and sustainability as the journey.

When Eco-Friendly Is Not Fully Sustainable

Let us take an example.

Paper straws are often called eco-friendly because they replace plastic straws. But if the paper comes from forests that were cut unsustainably, and the manufacturing process uses large amounts of water and energy, is it truly sustainable?

Another example: An electric car produces no exhaust pollution, making it eco-friendly in use. But what about the mining of lithium for its battery? What about electricity generation? Sustainability looks at the entire life cycle — from raw materials to disposal.

This is why scientists and policymakers often talk about Life Cycle Assessment (LCA) — a method used to measure the environmental impact of a product from cradle to grave.

The Rise of Greenwashing

Because these words are popular, many companies use them loosely. This is called greenwashing - when brands falsely claim to be environmentally responsible to attract customers.

You might see labels like:

- "100% Natural"
- "Green Choice"
- "Planet Safe"

But without clear data, certifications, or transparency, these claims can be misleading.

Organizations like United Nations Environment Programme and international sustainability frameworks such as the United Nations Sustainable Development Goals (SDGs) help set global standards for responsible practices.

As young scientists, your superpower is **critical thinking.** Always ask:

- Who made this claim?
- Is there scientific evidence?
- Are there certifications?
- What is the full life cycle impact?

Why This Matters for India

India is one of the fastest-growing economies in the world. With rapid urbanization, industrial growth, and increasing consumption, the difference between eco-friendly and sustainable becomes even more important.

From renewable energy projects in Rajasthan to water conservation efforts in Gujarat, sustainability is shaping national policies. The country's push for solar energy, electric mobility, and waste segregation shows that sustainability is no longer optional - it is essential.

For students, this opens exciting possibilities:

- Green entrepreneurship
- Environmental research
- Climate policy
- Sustainable architecture
- Circular economy innovations

The future needs not just inventors, but **responsible inventors.**

Think Like a Young Scientist

To truly understand sustainability, you must think beyond trends.

Ask yourself:

- Where do the materials come from?
- Who benefits and who might suffer?
- How long will this solution last?
- What happens when it is thrown away?

This systems-thinking approach is what distinguishes a true scientist from a casual observer.

Remember: Sustainability is not about perfection. It is about progress.

Classroom Activity: The Product Detective Challenge

Here is an activity teachers and students can try together:

Step 1: Bring any product from home – a notebook, a water bottle, a chocolate wrapper, or a T-shirt.

Step 2: Investigate.

- What material is it made of?
- Where was it manufactured?
- How is it packaged?
- Can it be reused or recycled?

Step 3: Classify it.

- Is it eco-friendly?
- Is it sustainable?
- Or is it neither?

Step 4: Propose improvements.

How would you redesign it to make it truly sustainable?

This activity develops research skills, critical thinking, and design innovation – all key traits of young scientists.

The Future Is Circular

The next big step beyond sustainability is the **circular economy** – a system where products are designed to be reused, repaired, refurbished, and recycled, minimizing waste.

Instead of the traditional "take-make-dispose" model, the circular model encourages:

- Sharing platforms
- Repair culture
- Composting
- Material recovery

Young innovators across India are already building start-ups that convert agricultural waste into packaging, turn plastic into road materials, and create bio-based textiles.

These ideas move beyond eco-friendly products toward **sustainable systems**

The Final Takeaway

Eco-friendly choices reduce harm. Sustainable systems create long-term balance.

Both are important. But sustainability demands deeper thinking, better science, and long-term vision.

As students reading this magazine, you belong to a generation that will witness some of the most significant environmental challenges — and solutions – in human history. Climate change, biodiversity loss, water scarcity, and waste management are not distant issues; they are shaping your future.

The real question is not whether you will hear these buzzwords.

The real question is:

Will you decode them, question them, and build something better?

Because the future does not just need products that look green.

It needs minds that think sustainably.

And that journey begins with understanding the difference.

Regional Science Centre Arunachal Pradesh

Imagine a place where science is not just read from textbooks but seen, **touched, and experienced.** That's exactly what the **Regional Science Centre Arunachal Pradesh** offers to students and visitors in India's northeastern frontier.

Located in **Itanagar**, the capital of Arunachal Pradesh, the Regional Science Centre is an important hub for **science education and public awareness.** It is part of India's network of science centres developed to make learning science fun, interactive, and meaningful—especially for school students. The centre aims to spark curiosity and encourage young minds to explore how science works in everyday life.

Unlike a regular classroom, the Regional Science Centre uses **interactive exhibits**, **models, and demonstrations** to explain scientific concepts. Students can learn about physics, biology, mathematics, and environmental science by pressing buttons, turning wheels, and observing real-life experiments. This hands-on learning helps students understand complex ideas simply and enjoyably.

A special focus of the centre is on **nature, environment, and local geography.** Arunachal Pradesh is known for its rich biodiversity, forests, rivers, and mountains. The science centre helps students understand topics like climate, ecosystems, conservation, and sustainable living—connecting science to the region they live in. This makes learning more relatable and inspires students to care for their natural surroundings.

Many modern leather products used in India and sold across the world are based on technologies developed at CLRI. The institute also provides training to students, technicians, and entrepreneurs, helping young people build careers in science and industry.

For school students, CLRI is a great example of how **science meets design and sustainability.** It shows that science is not limited to laboratories—it shapes what we wear and use every day.

If you enjoy experimenting, solving practical problems, or creating things that are useful and stylish, CLRI shows how science can turn curiosity into real-world impact. Who knows—your next science idea could help make the leather industry greener and smarter!

The centre also organizes science shows, workshops, quizzes, exhibitions, and science camps for school children. These activities encourage questioning, experimentation, and logical thinking. Teachers and students from nearby schools regularly visit the centre to make learning more exciting beyond the classroom.

For students, the Regional Science Centre of Arunachal Pradesh shows that science is not difficult or boring—it is curious, creative, and everywhere around us. Whether you dream of becoming a scientist, engineer, doctor, or environmentalist, this science centre reminds you that big ideas often begin with small questions. All it takes is curiosity, observation, and the courage to ask, "Why?"

Indian Scientist

Dr. Jagadish Chandra Bose

(30 November 1858 - 23 November 1937)

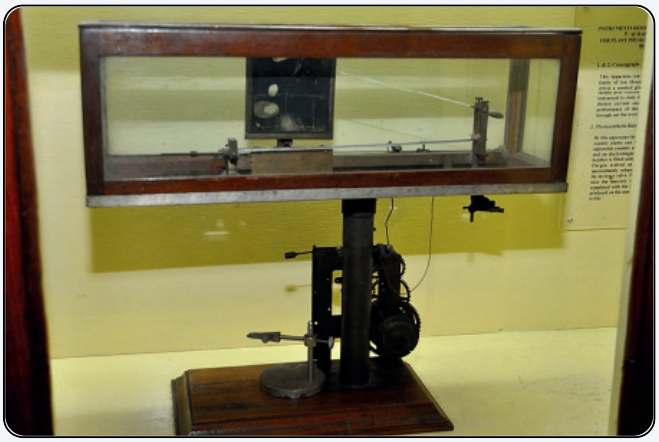
At a time when science was dominated by Western discoveries, Sir Jagadish Chandra Bose quietly reshaped the world's understanding of life and technology. A physicist, biologist, and inventor, he refused to confine himself to one field. His curiosity crossed boundaries - and that is what makes his story so powerful.

In the late 19th century, Bose conducted pioneering research in radio waves, even before wireless communication became widespread. Yet he chose not to patent many of his inventions, believing knowledge should serve humanity rather than personal profit.

Later, he turned his attention to plants. Through his invention, the crescograph, Bose demonstrated that plants respond to stimuli such as light, heat, and sound. His experiments challenged the belief that plants were passive life forms. He showed that life is deeply interconnected - a revolutionary idea for his time.

He also founded the Bose Institute in 1917, one of India's earliest modern research institutions, dedicated to scientific inquiry across disciplines.

What makes Bose inspiring is not just his discoveries, but his mindset. He combined science with philosophy. He worked with patience and precision. He questioned accepted ideas - and then proved his answers through experimentation.



Classroom Exploration Activity

Invite students to observe a plant over one week.

Ask them to:

- Note changes in growth, light direction, or leaf movement.
- Discuss how plants respond to their environment.
- Reflect on how science helps us see what is otherwise invisible.

Students can present their observations in charts or short reports.

Through this activity, they begin to experience what Bose demonstrated: innovation starts with careful observation and the courage to question assumptions.

Jagadish Chandra Bose did more than conduct experiments.

He expanded how we understand life itself.

Innovation Training Module

Prioritization Techniques

Choosing the Best Idea with Logic

Innovation often begins with many ideas. Students may brainstorm several possible solutions to a problem-ways to save water in school, reduce plastic waste, or improve transportation. However, in real life, not every idea can be implemented. Time, resources, and effort are limited. This is where **prioritization** becomes important.

Prioritization is the process of deciding **which ideas, tasks, or solutions should be addressed first** based on their importance and impact.

Scientists, engineers, entrepreneurs, and policymakers use prioritization techniques to focus their energy on the most effective solutions. Teaching students this skill helps them think more logically and make better decisions when solving real-world problems.

For teachers, prioritization techniques are also powerful classroom tools. They help students organize their thinking, work collaboratively, and learn how to evaluate ideas systematically rather than randomly choosing an option.

Why Prioritization Matters

When students brainstorm ideas, they often generate many possibilities. While this creativity is valuable, students may struggle to decide **which idea is the best one to pursue.**

Prioritization helps students:

- Focus on ideas that create the greatest impact
- Understand the trade-offs between different choices
- Learn how to make evidence-based decisions
- Work collaboratively to evaluate options

Technique 1: Simple Ranking

The simplest way to prioritize ideas is **ranking**.

Students list their ideas and arrange them from **most useful to least useful** based on discussion and reasoning.

Example

If students brainstorm ways to reduce plastic waste in school, they might list:

- Installing water refill stations
- Encouraging reusable lunch boxes
- Organizing plastic collection drives
- Reducing plastic packaging in the school canteen
- Awareness posters

Students then discuss which ideas would have the **greatest impact** and rank them accordingly.

Classroom Activity

Step 1: Divide the class into small groups.
Step 2: Ask each group to brainstorm **five solutions to reduce food waste in the school canteen.**

Step 3: Ask students to rank their ideas from **1 (most effective) to 5 (least effective).**

Step 4: Each group explains why they ranked their top idea first.

This activity encourages **discussion, reasoning, and justification of choices.**

Technique 2: Dot Voting

Dot voting is a quick and engaging prioritization method that works very well in classrooms.

Each student is given a few votes (or "dots") and places them next to the ideas they think are most promising.

How It Works

1. Write all ideas on the board.
2. Give each student **three votes.**
3. Students place their votes next to the ideas they prefer.
4. Count the votes and identify the **top ideas.**

This method ensures that **every student participates in the decision-making process.**

Classroom Activity

Ask students to brainstorm **ways to make their classroom more environmentally friendly.**

Examples may include:

- Switching off lights when not needed
- Using recycled paper
- Planting indoor plants
- Reducing paper usage
- Setting up waste segregation bins

Write all ideas on the board and conduct **dot voting.** The top two or three ideas can then be explored further.

Teachers often find this technique useful because it is **fast, democratic, and easy to implement.**

Technique 3: Impact vs Effort Matrix

One of the most widely used prioritization tools in innovation and project management is the **Impact vs Effort Matrix.**

This tool helps students evaluate ideas based on two questions:

- **Impact:** How much positive change will this idea create?
- **Effort:** How difficult will it be to implement?

Teachers can draw a simple **four-quadrant grid** on the board.

	Low Effort	High Effort
High Impact	Best Ideas	Long-Term Projects
Low Impact	Quick Tasks	Avoid

How to Use It in Class

Students place their ideas into one of the four boxes.

Ideas with **high impact and low effort** are usually the best starting points.

Example

Suppose students are exploring ways to **save electricity in school**.

Ideas may include:

- Turning off fans and lights when leaving a room
- Replacing bulbs with LED lights
- Installing solar panels
- Awareness posters about electricity use

Students may place them in the matrix like this:

- **High Impact, Low Effort:** Turning off lights and fans
- **High Impact, High Effort:** Installing solar panels
- **Low Impact, Low Effort:** Posters

This helps students understand that some ideas are **easy to implement but may not create large impact**, while others may require **more resources but offer bigger benefits.**

Technique 4: The 80/20 Principle (Pareto Principle)

Another useful concept in prioritization is the Pareto Principle, also known as the 80/20 rule.

For example:

- 20% of solutions may solve **80% of the problem**
- A few key ideas may have the **largest impact**

Teaching this concept encourages students to focus on **the most influential solutions rather than many small ones.**

Classroom Discussion

Ask students:

"If you could only choose **two ideas** to improve waste management in school, which ones would make the biggest difference?"

Students quickly learn that **prioritization is about focusing on the most meaningful actions.**

Connecting Prioritization to Decision Matrix Analysis

Prioritization techniques help students **narrow down many ideas into a few strong options.**

Once the top ideas are identified, students can move to a more structured tool such as **Decision Matrix Analysis.**

A decision matrix allows students to compare options based on clear criteria such as:

- Cost
- Feasibility
- Environmental impact
- Time required
- Long-term benefits

This process helps students move from **creative thinking to analytical decision-making.**

Teacher's Quick Classroom Guide

Teachers can use the following simple structure during innovation activities:

Step 1: Define the Problem
Example: How can our school reduce plastic waste?

Step 2: Brainstorm Ideas
Students generate multiple possible solutions.

Step 3: Prioritize Ideas
Use one of the following tools:

- Ranking
- Dot voting
- Impact vs Effort matrix

Step 4: Select Top Ideas
Choose the best 2-3 ideas.

Step 5: Evaluate Using Decision Matrix
Compare options logically and choose the final solution.

This process helps teachers **structure problem-solving activities without needing complex preparation.**

Reflection Questions for Students

Teachers may end the activity with a short reflection:

- Which idea did your group choose and why?
- Which idea had the highest impact?
- Which idea was easiest to implement?
- Did different groups prioritize different solutions? Why?

These questions encourage **critical thinking and deeper understanding.**

Conclusion

Prioritization is a key skill in innovation and decision-making. It helps students move from **many ideas to meaningful action.**

By using simple techniques such as **ranking, dot voting, the Impact vs Effort matrix, and the Pareto Principle,** teachers can guide students to evaluate ideas logically and collaboratively.

More importantly, these techniques show students that **good decisions are rarely random—they are made by carefully weighing options and focusing on what matters most.**

With these tools, classrooms can become spaces where students not only generate creative ideas but also learn how to **choose the best path forward.**

Riddles 2601

1. I'm a type of bond, but I'm not between people. What am I?
2. I grow in the dark, yet I can bloom without the sun. What am I?

(Answers on Back Cover Inside)

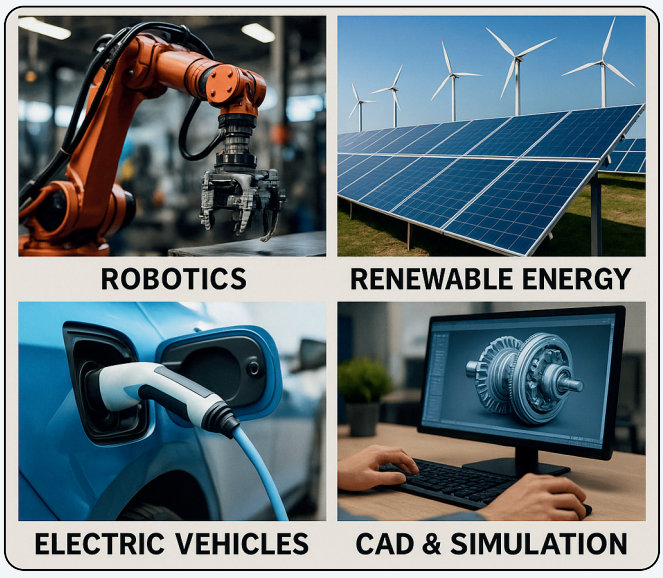
Science & Innovation Lab

Central Mechanical Engineering Research Institute (CSIR-CMERI), Durgapur

Have you ever wondered how machines are designed to make life easier—from water pumps in villages to robots in factories? Behind many such innovations is the **Central Mechanical Engineering Research Institute (CMERI),** one of India's leading centres for mechanical engineering research.

CMERI was established in **1958** and is located in **Durgapur, West Bengal**. It functions under the **Council of Scientific and Industrial Research (CSIR)**. The institute's main goal is to use engineering and technology to solve real-life problems faced by society, industry, and rural communities.

At CMERI, scientists and engineers design, test, and improve **machines, tools, and mechanical systems.** Their research covers areas such as manufacturing, robotics, automation, energy systems, and agricultural machinery. From developing advanced factory equipment to creating simple, low-cost machines for farmers, CMERI blends high-tech innovation with practical needs.



One of CMERI's special strengths is designing technologies for rural and small-scale industries. The institute has developed affordable machines for irrigation, food processing, renewable energy, and sanitation. These inventions help improve productivity, reduce manual labour, and support sustainable development across India.

CMERI also works on **cutting-edge technologies** like robotics, artificial intelligence in manufacturing, and smart mechanical systems.

By using computer simulations and modern testing labs, scientists ensure that machines are safe, efficient, and durable. Many of CMERI's technologies are transferred to industries, helping Indian manufacturing grow stronger and more competitive.

CMERI also plays an important role in **inspiring young minds.** The institute regularly conducts workshops, internships, exhibitions, and science outreach programs for school and college students. These programs allow students to see real laboratories, interact with scientists, and understand how ideas turn into working machines. CMERI shows students that innovation is not only about complex equations, but it starts with observing problems around us and thinking creatively to solve them. Whether it is saving energy, improving farming tools, or building smarter machines, CMERI encourages students to dream big and use engineering to make the world a better place.

For school students, CMERI shows how **physics, mathematics, and creativity come together** to build the world around us.

R-Brush (Reusable Brush)

Alok Kushwaha
8th Class

Every three to four months, millions of toothbrushes are thrown away and replaced. Since most toothbrushes are made of nearly 99% plastic, this routine habit generates billions of plastic units globally each year. These discarded brushes end up in landfills and oceans, contributing to long-term environmental pollution and increased carbon emissions from manufacturing and transportation. Despite being a daily necessity, the traditional toothbrush design is wasteful and unsustainable, highlighting the urgent need for an eco-friendly alternative.

R-Brush offers a simple yet impactful solution. Instead of discarding the entire toothbrush, this innovative design separates the bristle head from the reusable handle. Users can easily rotate and remove the old head and attach a new one, similar to tightening a nut and screw. The sturdy body can be reused multiple times, significantly reducing plastic consumption. Replacement heads are affordable – costing around ₹20 – making the product both economical and environmentally responsible. By lowering material usage, reducing transport emissions, and minimising landfill waste, R-Brush transforms an everyday habit into a conscious step toward sustainability.

(Source: GYS Avishkar Awards 2025 Booklet)

Link for the project's video presentation
YouTube.com/@GETAYoungScientist

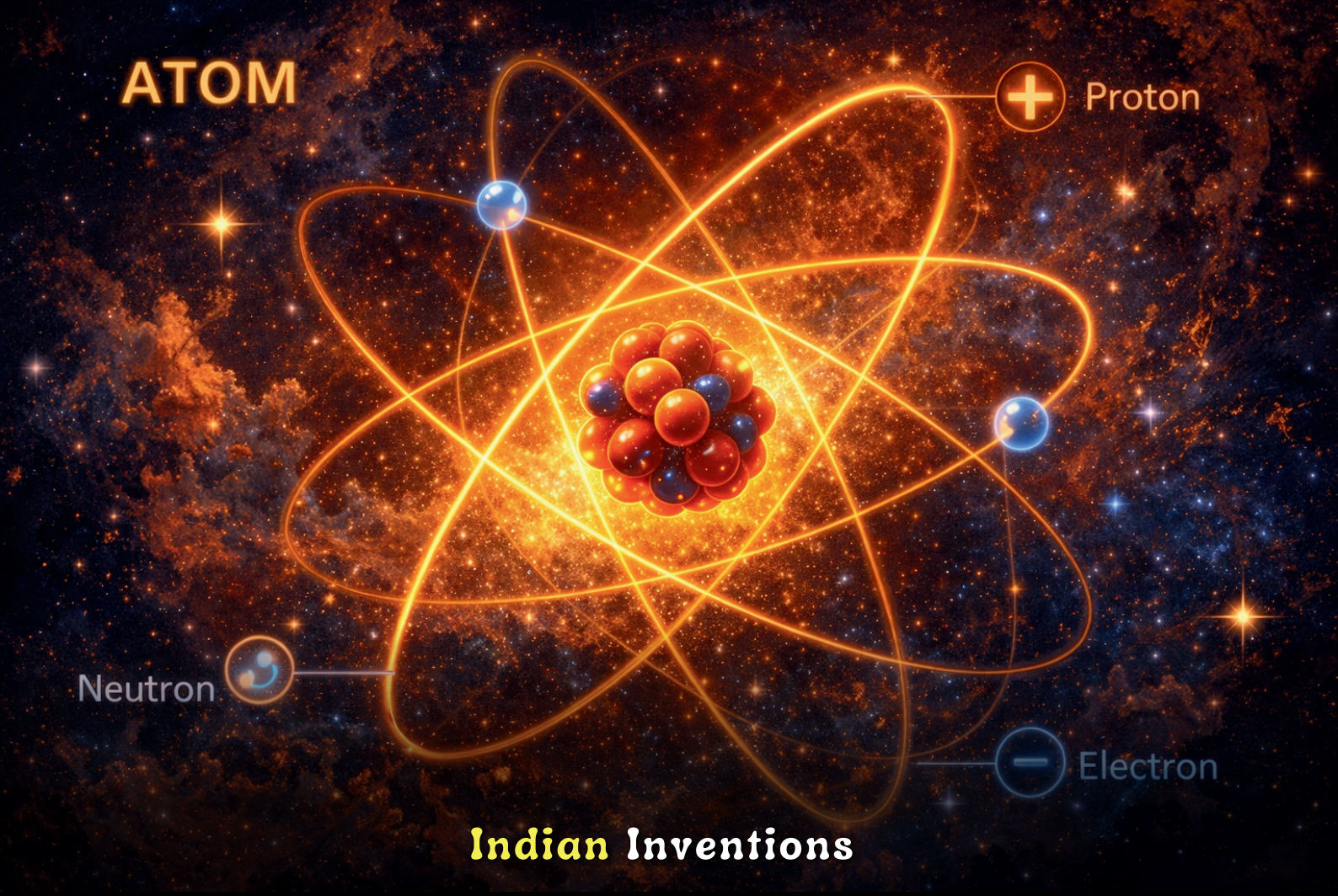
Water Fuel

Himanshu Agrawal
10th Class

With rising prices of petrol, diesel, and CNG, the search for affordable and cleaner fuel alternatives has become urgent. At the same time, nearly three-fourths of the Earth's surface is covered with saltwater, which cannot be directly used for drinking or agriculture. This project explores how ionized water - water mixed with salt or acid - can be converted into usable fuel. Based on the scientific principle of electrolysis, when electricity is passed through ionized water, the water molecules split into hydrogen and oxygen gases. Hydrogen, a highly combustible gas, can serve as a clean energy source without releasing harmful carbon monoxide when burned.

Using simple materials such as an empty battery, silver rods, plywood, and wires, the model demonstrates how salty water, urine, or wastewater can be converted into fuel gas. The system can be installed in homes and powered by solar panels to generate gas for cooking, potentially replacing LPG. The gas can also be used to run vehicles or generate electricity by powering a dynamo. This innovative idea transforms waste and abundant water resources into a cleaner, eco-friendly fuel alternative for a sustainable future.

(Source: INSPIRE MANAK NLEPC 2012 Booklet)



Indian Inventions

The Concept of Atom

From Ancient India to Modern Science

Have You Ever Wondered What Everything Is Made Of?

Your school bag, the air you breathe, the water you drink, and even your own body, everything is made up of **tiny particles called atoms.** These particles are so small that they cannot be seen even under a microscope. But did you know that thousands of years ago, Indian thinkers had already imagined the atom?

Yes! The idea of the atom, the smallest unit of matter, has deep roots in Indian philosophy, long before modern science confirmed it. This article will take you on a journey through history, science and student-friendly innovations based on the concept of the atom.

Ancient Indian Thinkers and the Atom

In ancient India, around **6th century BCE**, great philosophers like **Acharya Kanada** introduced the idea of an invisible particle called "**Anu**" (meaning atom) and "**Paramanu**" (sub-atomic particle). He believed:

Everything in the universe is made of indivisible particles. These particles combine in various ways to form different types of matter. The motion and interaction of these particles explain all physical changes.

Acharya Kanada is known as the **Father of Atomic Theory in India,** much before the Greek philosopher **Democritus** proposed a similar idea in the West.

Fun fact: The word Kanada comes from "**Kana**" meaning "**particle**" because he was always curious about small things!

What Is an Atom in Modern Science?

Today, science defines the atom as the basic building block of all matter. An atom consists of:

A **nucleus** in the center (made of protons and neutrons). **Electrons** revolving around the nucleus in orbits or shells.

This structure was discovered over many years through experiments by scientists like:

Scientist	Contribution
John Dalton	First modern Atomic theory
J.J. Thomson	Discovered the electron.
Ernest Rutherford	Proposed nucleus and proton.
Niels Bohr	Explained electron orbits.
James Chadwick	Discovered the neutron.

Even though these discoveries were made much later, Acharya Kanada's basic idea that matter is made of tiny, indivisible particles was surprisingly close!

The Science of Atoms: What You Should Know

Let's break down a few important scientific concepts about atoms that every young innovator should understand:

Everything Is Made of Atoms

Solids, liquids, gases, all forms of matter are just different arrangements of atoms.

For example, water (H_2O) is made from 2 hydrogen atoms and 1 oxygen atom.

Atoms Cannot Be Seen Easily

Atoms are less than one-millionth of a millimeter in size.

They can only be seen using advanced machines like electron microscopes.

Atoms Combine to Form Molecules

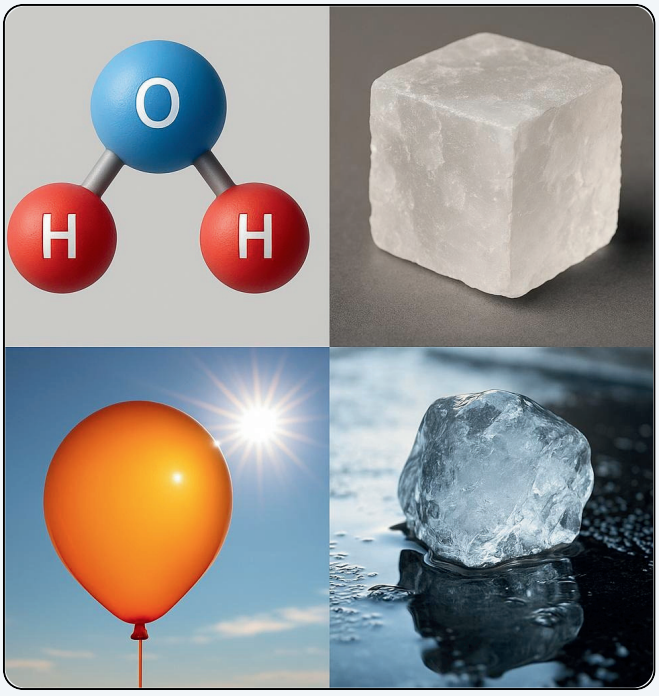
When atoms join together, they form molecules to the next level of structure.

For example: Salt (NaCl) is made of sodium and chlorine atoms.

Real-Life Examples for Students

Why Do Balloons Burst in the Sun?

When heated, the atoms of air inside the balloon move faster, pushing harder against the rubber until it bursts!



Why Is Cold Water Heavier Than Hot Water?

Atoms in cold water move slowly and stay closer together this makes the water denser (heavier). In hot water, atoms move faster and spread out more.

Why Do Magnets Attract?

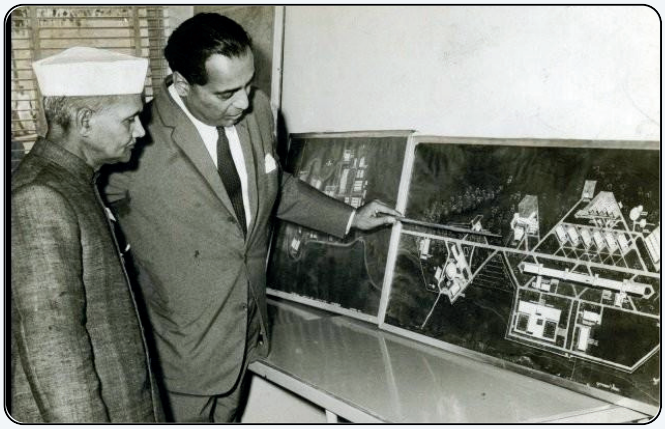
Atoms in magnets are arranged so their tiny particles (called electrons) spin in the same direction, creating magnetic fields.

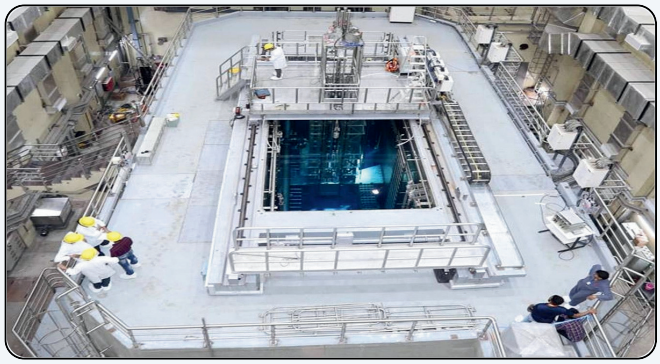
Indian Contributions in Atomic Research

India is not just a historical contributor Modern India is a leader in atomic science too.

Dr. Homi Bhabha: Father of India's Nuclear Program

He founded Tata Institute of Fundamental Research (TIFR) and Bhabha Atomic Research Centre (BARC).





Promoted peaceful use of atomic energy in medicine, electricity and agriculture.

Dr. A.P.J. Abdul Kalam

Worked on missile and defense technology using atomic principles.

Believed in the power of young minds to become scientists and innovators.

Atomic Research Centers in India

India has many research centers like BARC (Mumbai), IGCAR (Kalpakkam) and RRCAT (Indore).

These centers train scientists and help solve problems related to energy, environment and national development.

How Students Are Exploring Atomic Concepts

Students across India are doing exciting science fair projects using atomic and molecular principles. Here are some examples:

States of Matter Model – (Class 6, Karnataka)

Students created a working model to show how atoms are packed in solids, loosely in liquids and move freely in gases.

Air Purifier Using Activated Charcoal – (Class 10, Delhi)

This project used the idea that atoms in pollutants stick to the surface of activated charcoal due to atomic-level attraction.

Hydrogen Fuel Cell Model – (Class 11, Gujarat)

Inspired by atomic reactions, this project showed how hydrogen atoms can be split to produce clean electricity, a real future-tech idea!

DIY Activity: Model of an Atom

Want to make your own atom at home?

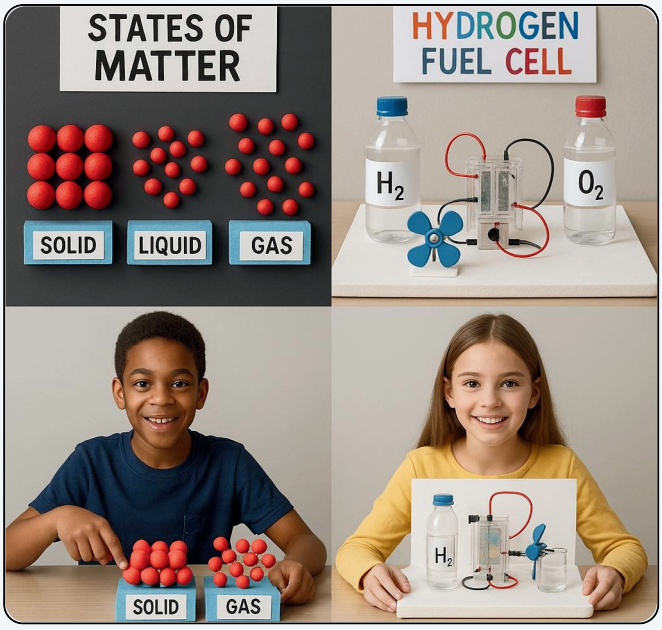
Materials

Styrofoam balls or clay (for protons, neutrons and electrons), Toothpicks or wires, A cardboard base, Markers for labeling

Steps

1. Create a nucleus using red (protons) and white (neutrons) balls.
2. Use wires to attach smaller blue balls (electrons) in circular paths.
3. Label the parts and explain your model to your classmates!

Concepts Learned: Atomic structure, electron shells, positive and negative charge.



Conclusion

Acharya Kanada didn't have a microscope. But he had imagination and curiosity. He observed the world, asked questions and thought deeply. That's what made him a true scientist, just like you can be! The atom is more than a topic in your science book. It is a key to understanding the world. Whether you're making a model, solving a problem or creating a new invention, your journey can start by thinking: "What is this made of?"

India has always been a land of knowledge. Now, it's time for you to carry that legacy forward not just by memorizing facts, but by asking questions, building models and solving real problems.

Riddles 2601

3. What can fill a room but takes up no space?
4. What has a bark but doesn't bite?
5. I come to life in the light, yet I thrive in the dark. I am essential for life, though I often leave no mark. What am I?

(Answers on Back Cover Inside)

Indian Scientist

Dr. Meghnad Saha

(06 October 1893 – 16 February 1956)

Great discoveries sometimes begin in the most unexpected places. **Meghnad Saha**, one of India's greatest physicists and astrophysicists, was born on **6 October 1893** in a small village called **Sheoratali** in present-day Bangladesh. He came from a poor family and faced many challenges while growing up, but his curiosity and determination helped him pursue science.

Saha developed a deep interest in mathematics and physics as a student. His passion for learning eventually led him to become a professor at the **University of Allahabad** and later at the **University of Calcutta**, where he taught and conducted important research.

His most famous contribution is the **Saha Ionization Equation**, developed in **1920**. This equation explains how atoms become ionized at very high temperatures inside stars. When scientists observe light coming from stars, they see patterns called **spectra** - lines that reveal which elements are present. Saha's equation helped astronomers understand why these spectral lines appear and what they tell us about the **temperature, pressure, and chemical composition of stars**.

Because of this discovery, scientists could better study **stellar atmospheres** and classify different types of stars. His work became a foundation of **modern astrophysics** and is still used by astronomers today.

Saha also believed that science should help build a nation. He played an important role in strengthening scientific research in India. He helped establish the **Saha Institute of Nuclear Physics** in Kolkata and encouraged scientific education across the country.

In recognition of his contributions, Saha was elected a **Fellow of the Royal Society** in **1927**, one of the highest honors for a scientist. He also served as the **President of the Indian Science Congress.**

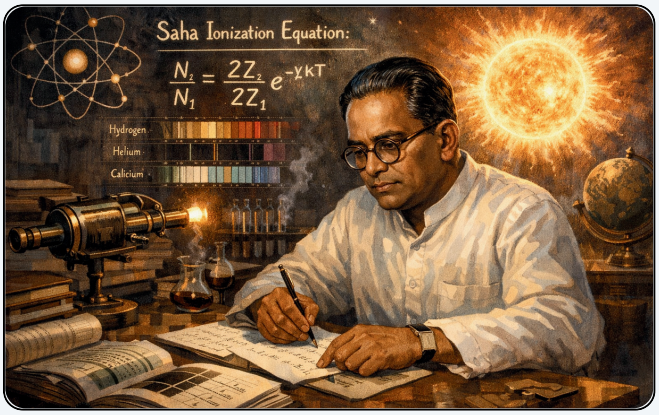
Think Like a Scientist

When you look at the night sky, remember that every star sends light filled with information.

Ask yourself:

- What secrets are hidden in starlight?
- How can science help us understand distant objects we cannot touch?

Meghnad Saha showed that with curiosity, mathematics, and imagination, even the light of distant stars can tell us their story.



Central Road Research Institute (CRRI)

The Central Road Research Institute (CRRI) is one of India's leading research institutions dedicated to road and transportation engineering. It was established in **1952** under the Council of Scientific and Industrial Research (CSIR) and is located in New Delhi. The institute was created to support the scientific development of India's road infrastructure at a time when the country was expanding its transportation network after independence.

CRRI plays an important role in conducting research related to **road construction, pavement design, traffic management, and transportation systems**. Its work helps improve the durability, safety, and efficiency of roads across the country. Scientists and engineers at the institute study different types of road materials, including bitumen and concrete, to develop stronger and longer-lasting pavements suitable for India's diverse climatic conditions.

One of CRRI's major contributions is in the field of **pavement technology and road maintenance.** The institute has developed techniques for recycling old road materials, which helps reduce construction costs and environmental impact. It also conducts studies on road failures and provides solutions to improve the quality of highways and urban roads.

CRRI also works extensively on **road safety and traffic engineering**. Researchers analyze accident patterns, traffic flow, and road design to recommend measures that can reduce accidents and improve transportation efficiency.

These studies support government agencies in planning safer roads and highways.

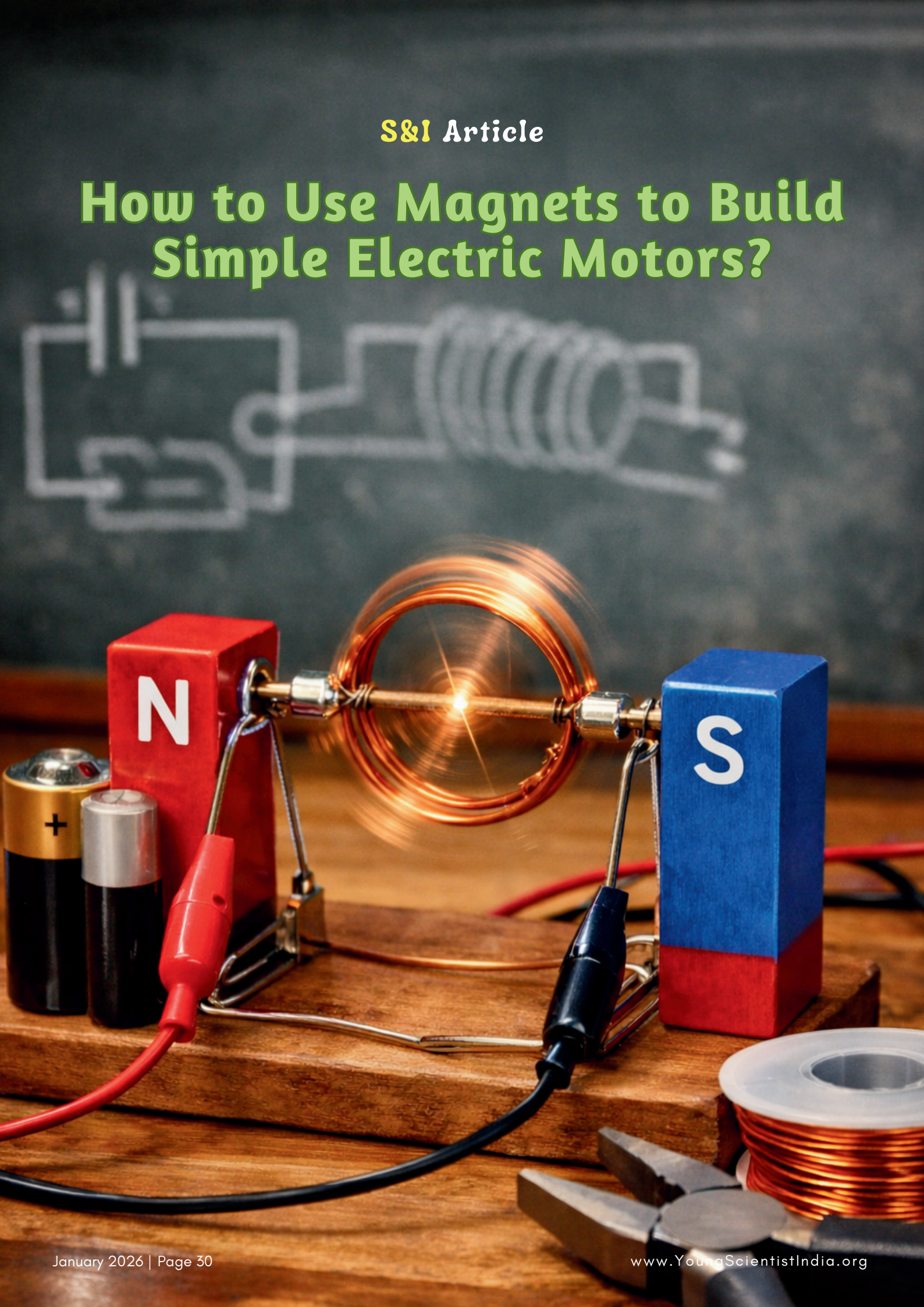
The institute also provides technical consultancy to various government bodies, including the Ministry of Road Transport and Highways and the National Highways Authority of India. In addition, CRRI conducts training programs for engineers and professionals working in the road construction sector.

CRRI is also involved in developing **sustainable and environmentally friendly road technologies**. Researchers at the institute explore the use of waste materials such as plastic and industrial by-products in road construction to reduce environmental impact. By promoting innovative and sustainable construction methods, CRRI contributes to building road infrastructure that supports both economic development and environmental protection.

Over the years, CRRI has made significant contributions to strengthening India's road infrastructure through research, innovation, and technical expertise. Its work continues to support the development of **safe, sustainable, and efficient transportation systems** in the country.

S&I Article

How to Use Magnets to Build Simple Electric Motors?



An electric motor changes electricity into movement. It uses magnets and electric current to make parts spin and create motion.

Building an Electric Motor

Materials You'll Need:

- 1 AA or 9V battery
- A piece of insulated copper wire
- 2 small strong magnets (neodymium magnets work best)
- 2 paperclips or a small metal stand
- Electrical tape
- Sandpaper

Steps to Build the Motor:

1. M**ake a Wire Coil:** Wrap the copper wire into a tight coil about 10 times around a small object (like a marker). Leave a few centimeters of straight wire sticking out on both ends – this is where the current will flow in.
2. **Strip the Wire Ends:** Use sandpaper to carefully remove the insulation from the ends of the wire. You need bare copper to make a good electrical connection.
3. **Set Up the Supports:** Bend the paperclips into a shape that can hold up the coil horizontally. Attach them to a base using electrical tape or place them in a stand. These will hold the coil and also act as the electrical contacts.
4. **Position the Magnets:** Place the magnets on a flat surface directly under the center of the coil. They should be strong enough to affect the coil when it carries current.
5. **Connect the Battery:** Tape the battery nearby. Touch each end of the coil to the battery terminals through the paperclip supports. Make sure the bare wire touches the metal part of the clips.
6. **Watch It Spin!** Once everything is connected, give the coil a small push. It should start spinning! The electricity flowing through the coil creates a magnetic field, which interacts with the magnets below to produce motion.

What's Happening?

When electric current flows through the wire coil, it generates a magnetic field. This magnetic field pushes against the field of the magnets, causing the coil to spin. As it spins, the direction of the magnetic force keeps changing, which helps the coil keep moving. This is the basic idea behind how all electric motors work!

What do we learn from this experiment?

- **Energy Conversion:** Shows how electrical energy changes into mechanical energy.
- **Electromagnetism:** Electric current in a coil creates a magnetic field that interacts with magnets to cause motion.
- **Magnetic Forces:** Attraction and repulsion between magnets produce rotation.
- **Scientific Inquiry:** Involves testing ideas and analyzing results.
- **Hands-On Engineering:** Provides experience in building and troubleshooting.
- **Physics Laws:** Applies Fleming's left-hand rule to explain motion direction.
- **Interdisciplinary Connections:** Demonstrates electric motors' role in everyday technology.

Applications of Electric Motors:

- Home Appliances: Power washing machines, refrigerators, mixers, and hair dryers for easier chores.

- **Transportation:** Drive electric cars, bikes, scooters, buses, and trams as clean alternatives to engines.
- **Industrial Use:** Operate conveyor belts, robotic arms, pumps, and heavy machinery for manufacturing.
- **Medical Equipment:** Enable precise movement in MRI machines, surgical robots, and infusion pumps.
- **Electronics and Gadgets:** Used in smartphones (vibration), drones, toothbrushes, and printers.
- **Energy and Renewables:** Power wind turbines and solar trackers for clean energy.
- **HVAC Systems:** Drive fans and pumps for heating and cooling.

These applications show how electric motors are essential in daily life, industry, healthcare, and clean energy.

Electric motors for the Innovative minds

Electric motors are very useful in student-level innovations because they make projects hands-on and exciting. For example, motors can power homemade cars, boats, or fans to show how electricity creates movement. Projects like scribble-bots, bristle bots, and simple robots use motors to draw, move, or dance, making science fun and creative.

By changing the number of magnets or batteries, you can test how speed and direction change, encouraging experimentation and problem-solving. Electric motors help turn science ideas into real, working models for learning and innovation.

Word Search 2601 - Polynomials

P	D	T	E	E	R	G	E	D	T	R	L	A	R
O	T	Q	G	O	C	A	I	D	O	N	X	T	I
X	R	O	N	O	I	T	I	D	D	A	R	N	C
P	I	C	R	A	T	A	A	S	Q	C	A	E	G
O	N	M	R	L	A	O	R	U	U	O	T	N	R
L	O	R	B	E	R	L	E	B	I	E	I	O	O
Y	M	E	I	L	D	A	A	T	N	F	O	P	U
N	I	T	N	B	A	I	B	R	T	F	N	X	P
O	A	C	O	A	U	M	O	A	I	I	A	E	I
M	L	U	M	I	Q	O	X	C	C	C	L	N	N
I	I	B	I	R	I	N	M	T	T	I	G	I	G
A	T	I	A	A	I	O	C	I	X	E	H	U	I
L	H	C	L	V	T	M	I	O	D	N	N	L	I
C	O	N	S	T	A	N	T	N	N	T	X	C	O

CONSTANT
BINOMIAL
MONOMIAL
RATIONAL
SUBTRACTION
POLYNOMIAL
TERM
EXPONENT
QUADRATIC
VARIABLE
COEFFICIENT
HEXIC
TRINOMIAL
AREA-BOX
ADDITION
DEGREE
QUINTIC
CUBIC
GROUPING

(Answers on Back Cover Inside)

UV Dry Boost

During the rainy season, wet shoes become a daily inconvenience. Damp footwear not only causes discomfort but also creates the perfect environment for fungal and bacterial growth. This can lead to problems such as athlete's foot, unpleasant odours, skin irritation, and even reduced productivity at school or work. Traditional drying methods, such as leaving shoes under a fan or in the sun, are often slow, uneven, and ineffective in eliminating germs. As a result, users continue to face hygiene risks and repeated infections, especially in humid climates.

Yatharth
9th Class

UV Dry Boost offers an innovative dual-action solution to this common problem. The device features a rotating platform that ensures 360-degree exposure of shoes to ultraviolet (UV) rays, effectively killing fungi, bacteria, and viruses. At the same time, a controlled hot air system operating at 35-40°C gently dries the footwear without damaging its material. By combining UV sterilisation with efficient warm air drying, the device ensures shoes are both dry and hygienic. Suitable for different types of footwear, UV Dry Boost provides a safe, fast, and reliable way to maintain comfort and foot health during rainy and damp conditions.

(Source: GYS Avishkar Awards 2025 Booklet)

Link for the project's video presentation
YouTube.com/@GETAYoungScientist

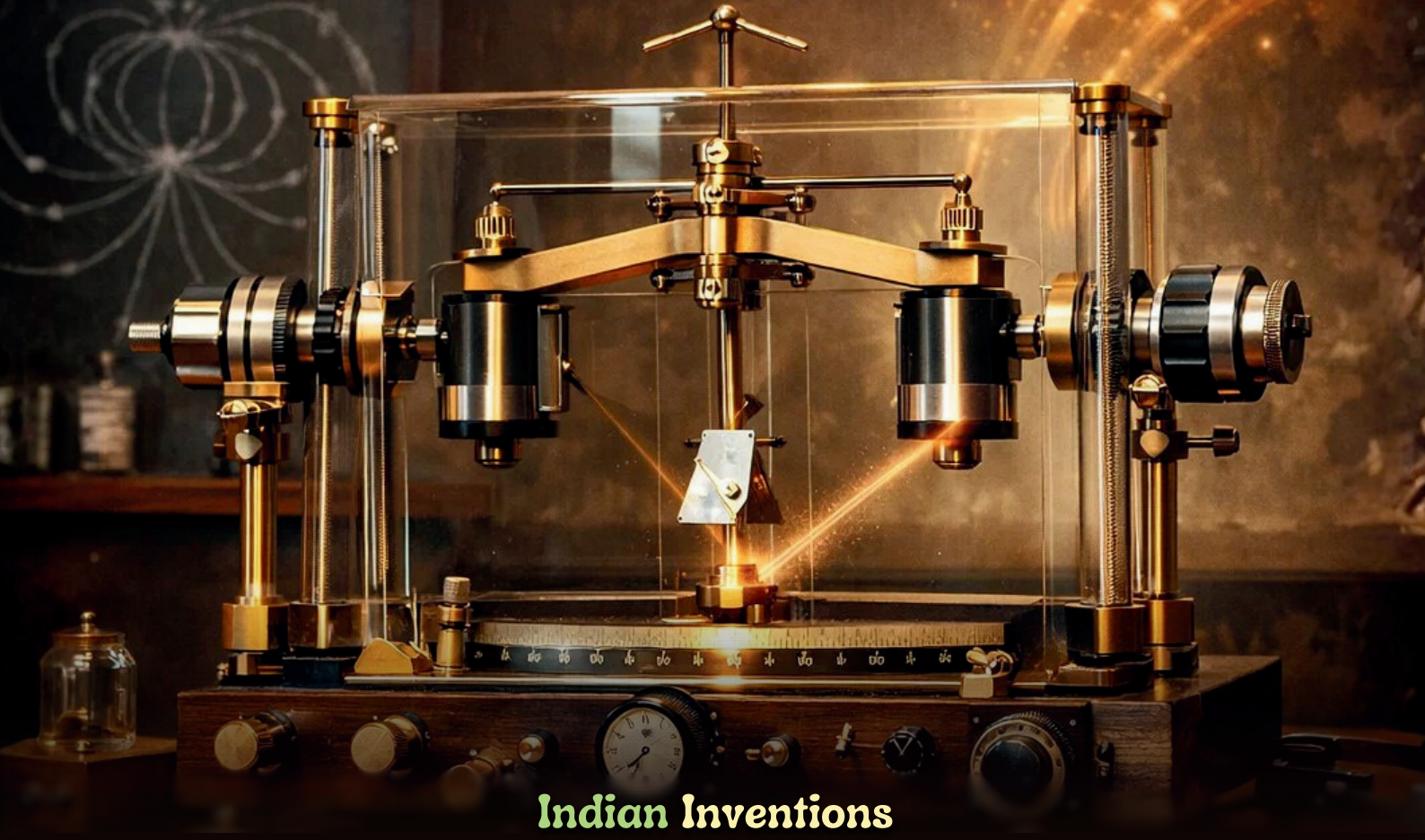
Vehicle Night Collision Safety Device

Bhupendra Singh Chouhan
10th Class

This project aims to reduce road accidents during nighttime driving caused by improper use of high-beam headlights. Many accidents occur when drivers fail to dim their headlights while approaching vehicles from the opposite direction, leading to temporary blindness and increasing the chances of collisions. With the rapid growth in the number of vehicles, nighttime road safety has become a critical concern in India.

The device works using photocells (light sensors) that detect the intensity of incoming light from oncoming vehicles. When strong light from a high beam is detected, the system automatically switches the vehicle's headlight from high beam to low beam. After the vehicle passes, the system restores the high beam. This automatic adjustment reduces glare, improves driver visibility, and helps prevent head-on collisions at night.

(Source: INSPIRE MANAK NLEPC 2016 Booklet)



Indian Inventions

Bhatnagar – Mathur Magnetic Interference Balance

The Bhatnagar-Mathur Magnetic Interference Balance is a scientific instrument invented in India in the 1930s by Dr Shanti Swarup Bhatnagar and Dr R. N. Mathur. It measures the magnetic susceptibility of materials, determining their attraction or repulsion by a magnetic field. The balance uses light interference and magnetic force to detect and measure these forces.

The invention was a significant achievement in experimental magnetochemistry, providing more accurate and reliable measurements than earlier methods like Gouy's balance. It also showcased India's growing strength in scientific research and instrument development. The Bhatnagar-Mathur balance is crucial in chemistry, physics, and material science, helping scientists study and understand the magnetic behavior of substances.

Inventors and Their Contributions

- **Dr Shanti Swarup Bhatnagar** – Founder Director of CSIR and pioneer of Indian scientific research.
- **Dr R. N. Mathur** – Collaborator and expert in magnetochemistry.

Their invention brought **international recognition** to Indian science and demonstrated India's early innovation in scientific instrumentation.

What is Magnetic Susceptibility?

Magnetic susceptibility (represented by the Greek letter χ, "chi") is a property that shows how a material behaves in a magnetic field:

- Paramagnetic substances → are weakly attracted to a magnet.
- Diamagnetic substances → are weakly repelled by a magnet.

The Bhatnagar-Mathur Balance helps scientists measure this behavior very accurately.

Principle: The instrument operates on the principle of light interference combined with the **magnetic force acting on a substance** in a magnetic field. When a material is placed in a non-uniform magnetic field, it experiences a small force depending on its magnetic properties. This force causes a slight deflection, which is detected through the **interference pattern of light**.

Construction/Parts of the Apparatus

The main parts of the instrument are

- **Magnetic system:** Produces a strong magnetic field.
- **Sample holder:** Holds the sample material securely.
- **Balance arm or quartz fiber:** Detects very small deflections due to magnetic forces.
- **Optical interference system:** Measures the displacement using light interference fringes.
- **Telescope or scale:** Helps observe and record the movement accurately.

Working/Experimental Procedure

The sample is placed in the magnetic field. Depending on its magnetic nature, it experiences a force that slightly moves the balance arm. This movement shifts the interference fringes of light. The shift in fringes is measured carefully, and from it, the magnetic susceptibility of the material is calculated.

Formula and Calculations

The magnetic susceptibility (χ) is calculated using the relation:

$\chi = \frac{F}{H \cdot \nabla H}$

$\chi = H \cdot \nabla F$

where

- FFF = magnetic force on the sample,
- HHH = magnetic field strength,
- ∇H\nabla H$\nabla H = gradient of the magnetic field.
- This gives a quantitative value of how strongly the sample is attracted or repelled by the magnetic field.

Types of Materials Studied

- **Paramagnetic materials**: Weakly attracted by a magnetic field (e.g., Fe^{3+}, Mn^{2+} salts).
- **Diamagnetic materials**: Weakly repelled by a magnetic field (e.g., Cu^{2+} complexes, organic compounds).

Advantages

- **Very high sensitivity and accuracy.**
- It can be used for both **solids and liquids.**
- Requires only a **small quantity of sample**.
- More reliable than older methods like Gouy's balance.

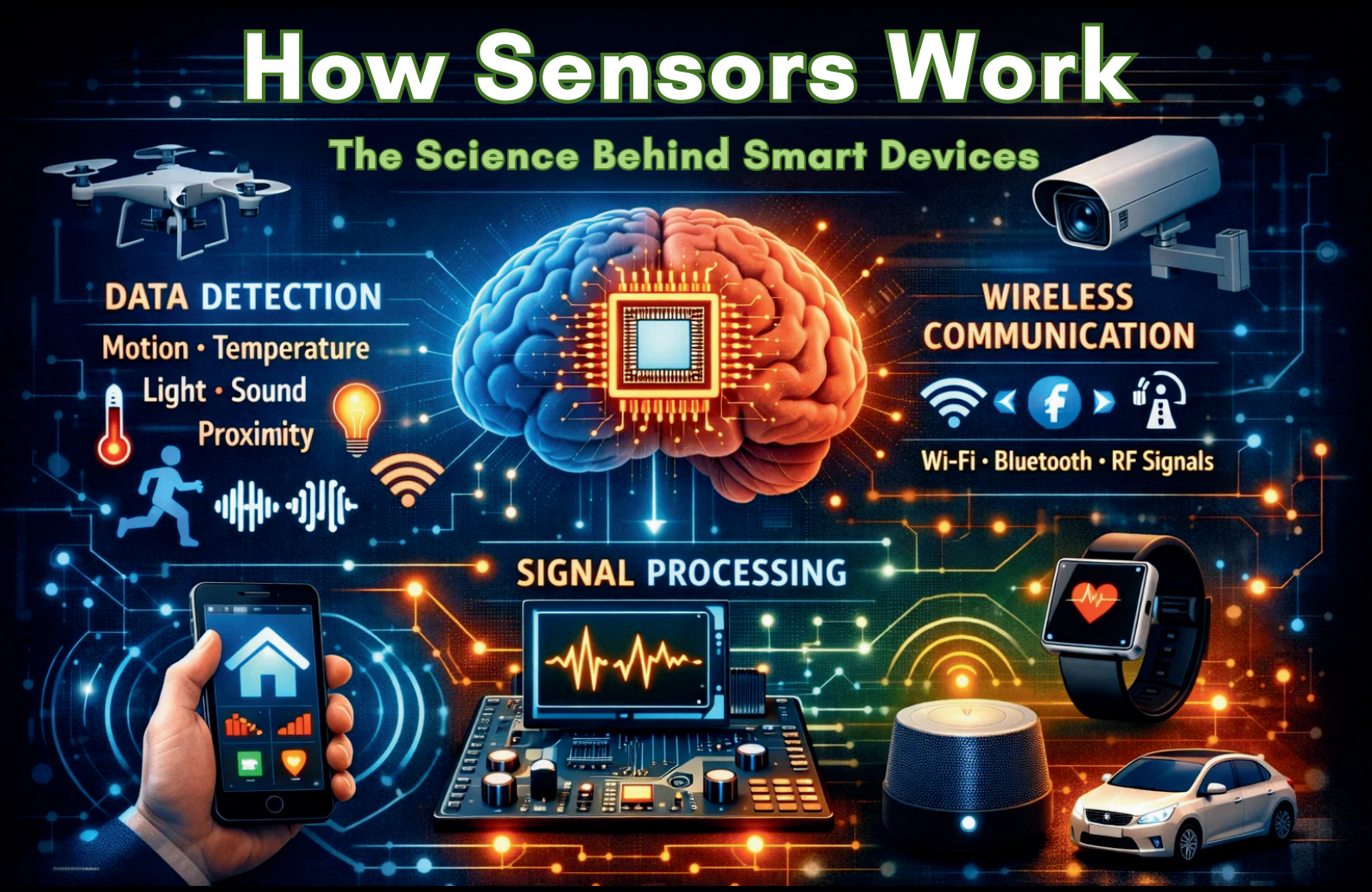
Limitations

- Needs careful calibration and alignment.
- Sensitive to vibrations and air currents.
- Only suitable for small and lightweight samples.

Applications

- Used to study the magnetic properties of chemical compounds.
- Helps determine oxidation states and bonding in transition metal complexes.
- Useful in material science and solid-state research.
- Commonly used in advanced chemistry and physics laboratories.

How Sensors Work



Have you ever wondered how your phone knows when you tilt it, how automatic doors open as you approach, or how a smartwatch counts your steps? The secret behind these smart devices is something small but powerful: **sensors.**

Sensors are the invisible heroes of modern technology. They help machines "feel," "see," "hear," and "measure" the world around them.

What Is a Sensor?

A sensor is a device that detects changes in the environment and converts them into signals that a machine can understand.

In simple terms, a sensor:

1. **Detects** something (like light, heat, motion, or sound)
2. **Converts** it into electrical signals
3. **Sends** that signal to a processor
4. The processor **responds** with an action

Without sensors, smart devices would not be smart at all.

Types of Sensors You Use Every Day

1. Motion Sensors

These detect movement. Automatic doors at malls and security lights use motion sensors. They often rely on infrared technology to sense body heat.

2. Light Sensors

Your phone automatically adjusts screen brightness depending on the lighting around you. That is the job of a light sensor measuring ambient light.

3. Temperature Sensors

Air conditioners, refrigerators, and even weather stations use temperature sensors to maintain balance.

4. Touch and Fingerprint Sensors

When you unlock your phone with your fingerprint, a sensor scans the unique ridges of your finger and matches them with stored data.

5. Ultrasonic Sensors

These are commonly used in robotics and parking systems. They send out sound waves and measure how long it takes for the echo to return. This helps calculate distance.

The Science Behind It

Most sensors work by detecting physical changes and converting them into electrical signals. For example:

- A **thermistor** changes resistance when temperature changes.
- A **photoresistor** changes resistance based on light intensity.
- An **accelerometer** measures changes in speed and direction.

These tiny changes in resistance, voltage, or frequency are read by a microcontroller (like Arduino or Raspberry Pi), which then processes the information.

In smartphones, companies like Apple and Samsung integrate multiple sensors – accelerometers, gyroscopes, GPS modules, and proximity sensors – into one compact device. That's why your phone can rotate the screen, track your fitness, and guide you through maps.

Sensors + AI = Smarter Devices

When sensors collect data continuously, Artificial Intelligence can analyze patterns.

For example:

- A smartwatch tracks your heart rate and detects irregular patterns.
- Smart irrigation systems measure soil moisture and water plants only when needed.
- Smart traffic lights adjust signals based on vehicle movement.

Sensors provide the **data**, and AI provides the **decision-making power.**

Try It Yourself: Mini Sensor Experiment

Students can explore sensors with simple projects:

- Build a temperature monitor using a basic thermistor.
- Create a smart dustbin using an ultrasonic sensor that opens automatically.
- Design a light-activated alarm system.

Using platforms like Arduino, beginners can understand how input (sensor data) becomes output (an action).

Why It Matters

Sensors are shaping the future – from healthcare and agriculture to climate monitoring and space exploration. They allow machines to respond quickly, reduce human effort, and improve accuracy.

The next time your phone screen dims automatically or a streetlight turns on at dusk, remember: a tiny sensor made that decision possible.

Smart devices are not magical. They are scientific.

And now you know the science behind them.

Innovation Training Module

Decision Matrix Analysis

Choosing the Best Idea with Logic

CHOOSE THE BEST IDEA

Option B has the highest score.

When students brainstorm solutions to a problem, they often come up with many creative ideas. For example, they might think of different ways to save water in school, reduce plastic waste, or improve energy efficiency. However, choosing the best idea is not always easy. Sometimes several ideas seem good, and students may struggle to decide which one to pursue.

This is where **Decision Matrix Analysis** becomes useful.

A **Decision Matrix** is a simple tool that helps people compare different options using clear criteria. Instead of choosing randomly or relying only on personal opinions, students evaluate each option in a structured way. This method is widely used by scientists, engineers, businesses, and policymakers when making important decisions.

For teachers, decision matrix analysis provides an easy way to guide students through logical thinking and collaborative decision-making.

What Is a Decision Matrix?

A **Decision Matrix** is a table used to compare several options against a set of criteria.

Each option is evaluated based on how well it satisfies the criteria, and scores are given for each factor. The scores are then added to identify the option that performs best overall.
The matrix helps students answer an important question:

Which solution works best when we consider multiple factors?

This approach teaches students that decisions should consider **different perspectives**, such as cost, feasibility, impact, and time required.

Understanding the Components of a Decision Matrix

A typical decision matrix has three main components:

1. Options

These are the different ideas or solutions students want to compare.

Example: If students want to reduce plastic waste in school, their options might include:

- Installing water refill stations
- Encouraging reusable lunch boxes
- Organizing plastic collection drives
- Running awareness campaigns

2. Criteria

Criteria are the factors used to evaluate each option. These are the aspects that matter when making a decision.

Common criteria used in classroom innovation activities include:

- Impact - How much positive change will the idea create?
- Cost - How expensive will it be to implement?
- Feasibility - How easy is it to implement?
- Time required - How quickly can it be implemented?
- Sustainability - Will the idea have long-term benefits?

Choosing the right criteria helps students think more carefully about the practical aspects of their ideas.

3. Scores

Each option is scored against the criteria using a simple scale such as **1 to 5**, where:

- 1 = Very Low
- 2 = Low
- 3 = Moderate
- 4 = High
- 5 = Very High

Higher scores indicate better performance for that criterion.

After scoring, students **add up the total score for each option.** The idea with the highest score may be the most suitable solution.

A Simple Example

Suppose students want to **reduce electricity usage in school.** After brainstorming and prioritizing, they select three possible ideas:

1. Turning off lights and fans when leaving a room
2. Replacing bulbs with LED lights
3. Installing solar panels

They decide to evaluate these ideas using the following criteria:

- Impact
- Cost
- Feasibility

Their decision matrix might look like this:

Idea	Impact	Cost	Feasibility	Total
Turn off Lights	4	5	5	14
LED Bulbs	4	3	4	11
Solar Panels	5	1	2	8

In this case, **turning off lights and fans** receives the highest score. This suggests that it is the most practical solution to start with.

Students learn an important lesson here: the **most powerful idea is not always the most practical one.** Sometimes simple actions can make a big difference.

Why Decision Matrix Analysis Is Useful for Students

Decision matrix analysis teaches several important skills:

Logical Thinking

Students learn to analyze options carefully instead of making decisions based only on personal preference.

Structured Problem-Solving

The matrix provides a step-by-step way to evaluate solutions.

Collaboration

Students discuss criteria and scoring together, which improves teamwork and communication.

Evidence-Based Decision Making

Students justify their choices using reasoning and evaluation.

These skills are essential not only in science and innovation but also in everyday decision-making.

Classroom Activity: Choosing the Best Environmental Idea

Teachers can easily use decision matrix analysis during project-based learning activities.

Step 1: Define the Problem

Ask students to explore a real-world challenge such as:
How can our school reduce plastic waste?

Step 2: Generate Ideas

Students brainstorm possible solutions. For example:

- Reusable water bottles
- Waste segregation bins
- Plastic-free lunch days
- Awareness campaigns

Step 3: Select Evaluation Criteria

As a class, identify criteria such as:

- Impact
- Cost
- Ease of implementation
- Long-term sustainability

Step 4: Create the Decision Matrix

Draw a simple table on the board and fill in the options and criteria.

Students then assign scores from **1 to 5** for each criterion.

Step 5: Calculate the Scores

Add the scores for each option and identify the idea with the highest total.

Step 6: Discuss the Results

Encourage students to reflect on questions such as:

- Did the highest-scoring idea surprise you?
- Which criterion influenced the decision most?
- Would you change the scores after discussion?

This reflection helps students understand the decision-making process more deeply.

Tips for Teachers

Decision matrix analysis works best when the process is kept simple and interactive.

Here are a few suggestions:

Use the board or chart paper

Teachers can draw the matrix on the board so the entire class can participate.

Limit the number of options

Comparing three to five ideas is usually manageable for students.

Keep criteria clear and relevant

Too many criteria can make the process confusing.

Encourage discussion before scoring

Students should explain their reasoning for each score.

Allow group work

Small groups can create their own matrices and then compare results with the class.

These strategies help teachers conduct the activity smoothly while keeping students actively engaged.

Connecting with Prioritization Techniques

Decision Matrix Analysis is often used **after prioritization techniques.**

For example:

1. Students **brainstorm ideas**.
2. They use **prioritization tools** such as ranking or dot voting to narrow down the options.
3. Finally, they apply **Decision Matrix Analysis** to select the best solution.

This sequence mirrors the real-world innovation process used in research, engineering, and business.

Reflection Questions for Students

Teachers may conclude the session by asking students:

- What criteria were most important in your decision?
- Did different groups choose different solutions?
- How did the decision matrix help you think differently?
- Would you use this method in other situations?

These questions encourage students to recognize the value of structured thinking.

Jeevan Rakshak Direction Controlled Vehicle Safety Device

Eashan Maurya
10th Class

Wrong-way driving is a major cause of road accidents in India, leading to thousands of preventable fatalities each year. Despite signboards, rumble strips, and traffic policing, drivers often enter one-way roads or highways in the wrong direction — especially at night, in low visibility, or due to negligence. These traditional warning systems rely heavily on human attention and enforcement, which are not always reliable. The absence of an automated preventive mechanism makes wrong-way driving a persistent and dangerous problem.

Jeevan Rakshak is a low-cost, sensor-based safety device designed to prevent such incidents automatically. The system uses a reflective photoelectric sensor installed in the vehicle and a roadside reflector placed strategically on restricted roads.

When a vehicle moves in the wrong direction, the sensor detects the reflected signal and immediately cuts off the ignition, stopping the vehicle before it can cause harm. The device is practical, tamper-resistant, and can be integrated into cars, buses, and trucks. By combining simple sensor technology with smart design, Jeevan Rakshak offers an effective and affordable solution to enhance road safety and save lives.

(Source: GYS Avishkar Awards 2025 Booklet)

Link for the project's video presentation
YouTube.com/@GETAYoungScientist

Bio-Filters Using Fungi

Sandra Anand
10th Class

Industries, solid waste facilities, poultry farms, and piggeries release foul-smelling and harmful gases called volatile organic compounds (VOCs). Traditional treatment methods like incineration, adsorption, and chemical scrubbing are costly and may cause secondary pollution, while conventional bacterial biofilters with topsoil struggle to remove hydrophobic compounds such as aromatic hydrocarbons and alkanes and face issues like acidification and drying.

To overcome these limitations, this project proposes an eco-friendly fungal biofilter made with topsoil, compost, Pleurotus mushroom spawn, old mushroom beds, cellulosic waste, and organic manure. Contaminated gases pass through this biologically active medium where fungi absorb and biodegrade pollutants, tolerate acidic and dry conditions, and degrade hydrophobic compounds better than bacteria. The system achieved up to 99% odour reduction and proved cost-effective for low VOC concentrations, offering a sustainable solution for controlling emissions in farms, industries, and sanitation facilities, improving air quality and environmental health.

(Source: INSPIRE MANAK NLEPC 2013 Booklet)

Central Scientific Instruments Organization (CSIO)

The Central Scientific Instruments Organisation (CSIO) is one of India's premier research institutions dedicated to the development of scientific and industrial instruments. It was established in **1959** under the Council of Scientific and Industrial Research (CSIR) and is located in Chandigarh. The institute was created to strengthen India's capacity in designing and manufacturing advanced scientific instruments needed for research, industry, healthcare, and national development.

CSIO plays a major role in research and development related to **scientific instrumentation, optical systems, sensors, and measurement technologies.** Scientists and engineers at the institute work on designing high-precision instruments that are used in laboratories, industries, and healthcare systems. These technologies help improve the accuracy, efficiency, and reliability of scientific measurements and industrial processes.

One of the key areas of CSIO's work is **optical and photonic instrumentation.** Researchers develop advanced optical devices such as imaging systems, laser-based instruments, and optical sensors used in medical diagnostics, environmental monitoring, and industrial quality control. The institute has also contributed to the development of instruments used in agriculture, electronics, and manufacturing industries.

CSIO also works on **healthcare technologies and biomedical instruments.** The organization has developed devices for medical diagnostics, patient monitoring, and rehabilitation. These innovations aim to provide affordable healthcare technologies that can be widely used across India.

The institute provides consultancy and technical support to government agencies, industries, and research institutions. Through collaborations with universities, startups, and industries, CSIO helps transfer laboratory innovations into practical technologies and commercial products.

In addition, CSIO conducts **training programs and skill development initiatives** for students, researchers, and professionals working in science and engineering fields. These programs help build technical expertise in instrumentation and applied research.

Over the years, CSIO has played an important role in strengthening India's scientific and technological capabilities. Through innovation, research, and collaboration, the institute continues to contribute to the development of **advanced instruments and technologies that support scientific progress and industrial growth in India**.

Fibonacci Numbers

The Fibonacci Numbers form a sequence that is one of the most famous and widely studied patterns in mathematics, appearing across many fields from number theory to nature and finance.

Definition and Sequence

The Fibonacci sequence is an infinite series of numbers where each number is the sum of the two preceding ones.

- **Initial Conditions (Starting Point):** The sequence conventionally begins with 0 and 1.

  F0=0
  F1=1

- **Recurrence Relation (The Rule):** For any number Fn in the sequence where n⩾2, the rule is: **Fn=Fn-1+Fn-2**
- **The Sequence:** 0, 1, 1, 2, 3, 5, 8, 13, 21, 34, 55, 89, 144, 233, 377,...

History (The Origin)

The sequence is named after the Italian mathematician **Leonardo of Pisa** (c. 1170-1250), known as Fibonacci.

- **Indian Roots:** The sequence was described centuries earlier in **Indian mathematics** (as early as 200 BCE) by Sanskrit scholars

like Pingala and later by Virahanka and Hemachandra, who used it in the analysis of rhythmic patterns (prosody) in Sanskrit poetry.

- **Western Introduction:** Fibonacci introduced the sequence to Western European mathematics in his 1202 book, Liber Abaci (The Book of Calculation). He presented it by solving a problem about the growth of an idealised rabbit population.

3 Key Mathematical Properties

A. Connection to the Golden Ratio (φ)

The most celebrated property of the Fibonacci sequence is its connection to the **Golden Ratio** (φ).

- **The Ratio Limit:** As you take the ratio of consecutive Fibonacci numbers, the result rapidly approaches the Golden Ratio: **n→∞limFn-1Fn=φ≈1.6180339887...**

Binet's Formula (Closed-Form): The n-th Fibonacci number can be calculated directly using φ: **Fn=5 φn-φn**

where φ=21+5 (the Golden Ratio) and φ=21-5 (its conjugate).

B. Identities and Relations

Fibonacci numbers satisfy many identities, including **Cassini's Identity**:
Fn-1Fn+1-Fn2=(-1)n

C. Relationship to Other Sequences

The Fibonacci numbers are closely related to the **Lucas Numbers** (Ln), which follow the same recurrence rule (Ln=Ln-1+Ln-2) but start with different initial values: L0=2, L1=1.

Applications (From Nature to Finance)

The Fibonacci sequence and the Golden Ratio appear in an astonishing range of fields.

Biology and Nature

Phyllotaxis: The spiral arrangement of leaves on a stem, seeds in a **sunflower head**, or florets in a cauliflower often contains a number of spirals that are consecutive Fibonacci numbers (e.g., 21 and 34, or 34 and 55).

Branching: The way trees branch or the structure of a drone bee's family tree follows the sequence.

Computer Science

Used in the analysis of the **Euclidean Algorithm** (where Fibonacci numbers are the worst-case input).

Basis for the **Fibonacci Search Technique**, an efficient method for finding the minimum of a unimodal function.

Used in data structures like the **Fibonacci Heap.**

Art and Architecture

The Golden Ratio is widely used in design (e.g., in the dimensions of the Parthenon or in Renaissance art) to create aesthetically pleasing proportions.

The **Fibonacci Spiral**, constructed by drawing quarter-circles inside squares whose side lengths are Fibonacci numbers, closely approximates the elegant **Golden Spiral** found in nature (like the shape of a nautilus shell).

Finance

Fibonacci Retracements: A tool in technical analysis used by traders to identify potential support and resistance levels in financial markets by using ratios derived from the sequence (e.g., 38.2%, 61.8%).

Indian Scientist

Dr. Srinivasa Ramanujan

(30 November 1858 - 23 November 1937)

Some scientists use laboratories filled with equipment. Others use telescopes or microscopes. But **Srinivasa Ramanujan** used something much simpler — a notebook, a pencil, and a mind that saw mathematics everywhere.

Born in **1887 in Erode**, **Tamil Nadu,** Ramanujan showed an unusual love for numbers from a very young age. While most students learned formulas from textbooks, he preferred discovering them himself. By his teenage years, he had already begun creating new mathematical ideas that puzzled even experienced scholars.

Ramanujan had very little formal training in mathematics. Yet he filled notebooks with thousands of formulas, patterns, and theorems. Many of them were so original that mathematicians around the world struggled to understand how he had discovered them.

In 1913, Ramanujan wrote a famous letter to **G. H. Hardy**, a mathematician at the **University of Cambridge**. Hardy immediately recognized Ramanujan's extraordinary talent and invited him to England. Their collaboration became one of the most remarkable partnerships in the history of mathematics.

Ramanujan made groundbreaking contributions to **number theory, infinite series**, and **mathematical analysis.** Today, his ideas influence fields such as computer science, cryptography, and even physics. One famous story about him involves the number **1729**, which he recognized as the smallest number expressible as the sum of two cubes in two different ways - a number now known as the **Hardy–Ramanujan number.**

What makes Ramanujan especially inspiring is that he trusted his curiosity. Many of his discoveries came from deep intuition and a love for patterns in numbers.

Try This Like Ramanujan

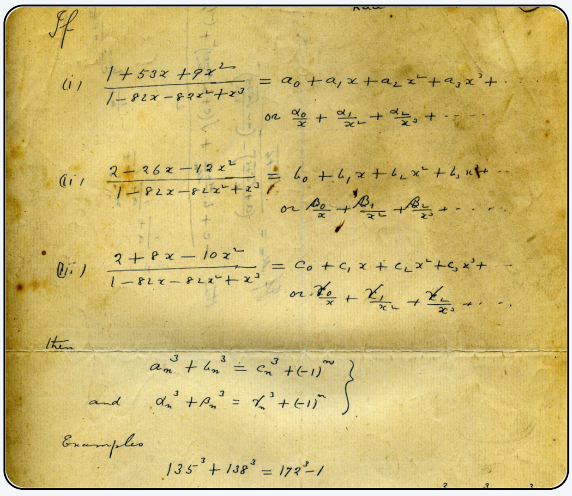
Look at the numbers from **1 to 20**. Can you find interesting patterns?

- Are there numbers that can be written in more than one mathematical way?
- Can you create your own number puzzle for your classmates?

Ramanujan reminds us that great discoveries often begin with a simple question:

"What pattern can I find here?"

For every young scientist, curiosity can be the starting point of something extraordinary.



Solution
Word Search 2601

P	D	T	E	E	R	G	E	D	T	R	L	A	R
O	T	Q	G	O	C	A	I	D	O	N	X	T	I
X	R	O	N	O	I	T	I	D	D	A	R	N	C
P	I	C	R	A	T	A	A	S	Q	C	A	E	G
O	N	M	R	L	A	O	R	U	U	O	T	N	R
L	O	R	B	E	R	L	E	B	I	E	I	O	O
Y	M	E	I	L	D	A	A	T	N	F	O	P	U
N	I	T	N	B	A	I	B	R	T	F	N	X	P
O	A	C	O	A	U	M	O	A	I	I	A	E	I
M	L	U	M	I	Q	O	X	C	C	C	L	N	N
I	I	B	I	R	I	N	M	T	T	I	G	I	G
A	T	I	A	A	I	O	C	I	X	E	H	U	I
L	H	C	L	V	T	M	I	O	D	N	N	L	I
C	O	N	S	T	A	N	T	N	N	T	X	C	O

Solution
Sudoku Challenge 2601

1	9	2	7	8	4	5	6	3
5	3	7	6	2	9	8	4	1
4	8	6	1	5	3	9	7	2
9	1	5	3	4	8	7	2	6
6	4	8	9	7	2	1	3	5
7	2	3	5	1	6	4	9	8
2	6	1	4	9	5	3	8	7
3	5	9	8	6	7	2	1	4
8	7	4	2	3	1	6	5	9

Riddle 2601 Answer

1. Chemical bond 2. Mushroom 3. Light 4. A tree 5. Photosynthesis.

GYS SWAMINATHAN SCIENCE DAY CONTESTS

A National Online Competition for 28 Feb 2026