THE BULLETEEN

MAGAZINE

Orsa

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ISSUE 1

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FROM THE EDITOR'S DESK

The first issue of the Bulleteen, “Orsa”, which means "New Beginnings" in Latin, is true to its name in every way. It is always the image of a plant blooming from the hardships it went through as a seed that conjures in our minds when we think of new beginnings. The Big Bang, the first cry of a newborn child, every eureka after a discovery and every change that has ever occurred all throughout time helps us realise that good and bad things alike start and continue to flourish in the pages of the Book of Time. With these thoughts in mind, The Bulleteen starts its journey with this first issue.

Issue 1 heralds the start of an informative and inclusive student-led publication with teenagers from over 10 countries at the present moment. This first issue introduces STEM to our readers through the favourite topics of our writers. Ranging from topics such as preserving history through technology to gender bias in STEM and STEM cells and the SPARROW algorithm, the articles bring a fresh perspective to many STEM topics and their insertions with other disciples.

The Bulleteen aims to increase the STEM participation of teenagers in an era where discoveries are made frequently and the world evolves faster than ever. Introduction to nuanced and niche STEM topics for everyone, even teenagers who do not intend to pursue STEM in their later years, is important now more than ever and we here at the Bulleteen are to do just that. We implore you to increase your curiosity and hope that this publication will aid you in doing so. Enjoy reading, understanding, learning and living through our issue!

Yours Truly,
Rhea Agrawal
Editor-In-Chief and Director of the Bulleteen

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Science Isn't Neutral, Actually.

STEM fields are commonly considered the purest form of objectivity. They are believed to uncover universal and unbiased insights into the workings of the natural world. However, feminist theory offers a more nuanced perspective. It suggests that science is shaped by the underlying assumptions and perspectives of those conducting it.

An example of this is given by the advances Barbara McClintock made in the field of genetics. Until then, DNA was considered the main decisive and steering factor in cellular organization. McClintock broke with this paradigm, proposing a more holistic framework that considers environmental influences as well as interactive processes. In 1983, McClintock was awarded a Nobel Price for her groundbreaking work.

According to Evelyn Fox Keller, the misconception that DNA alone exerts rational control over the chaotic nature of cells mirrors a broader tendency in modern science to dominate nature through rationality. Keller's feminist analysis reveals a connection to patriarchal ideas. Historically, traits such rationality and objectivity were associated with masculinity, while women were considered emotional and closer to nature. Consequently, science itself reflects these gendered biases and assumptions.

As McClintock's example shows, changing the underlying assumptions made in science is not only a matter of inclusion but a matter of the validity of science in general. There is no clear distinction between researcher and researched, subject and object. Our experiences and the systems we operate in limit the insights we can have. For genetic researchers, it had been simply impossible to phantom an organism without a rational control center. Acknowledging this situative nature of knowledge is what Keller calls dynamic objectivity. According to her, embracing dynamic objectivity and aiming to understand rather than dominate allows us to start doing science not as a masculine, but as a human project.

The Reign of Numbers: Data is Shaping Our Lives

Nowadays, numbers have become more powerful than ever. Data Analysis is used in every part of our day-to-day-lives, from corporate decision-making to personal self-tracking. This "reign of numbers" is transforming society and individuals alike, promising clarity and control, yet often merely subjecting individuals to the interests of those who control the data.

Transforming Work

People analytics is becoming increasingly common in large companies. It describes the usage of data to monitor workers' performances by collecting huge amounts of data on employee behavior, productivity and engagement. This data is then analyzed to optimize work processes and improve efficiency.

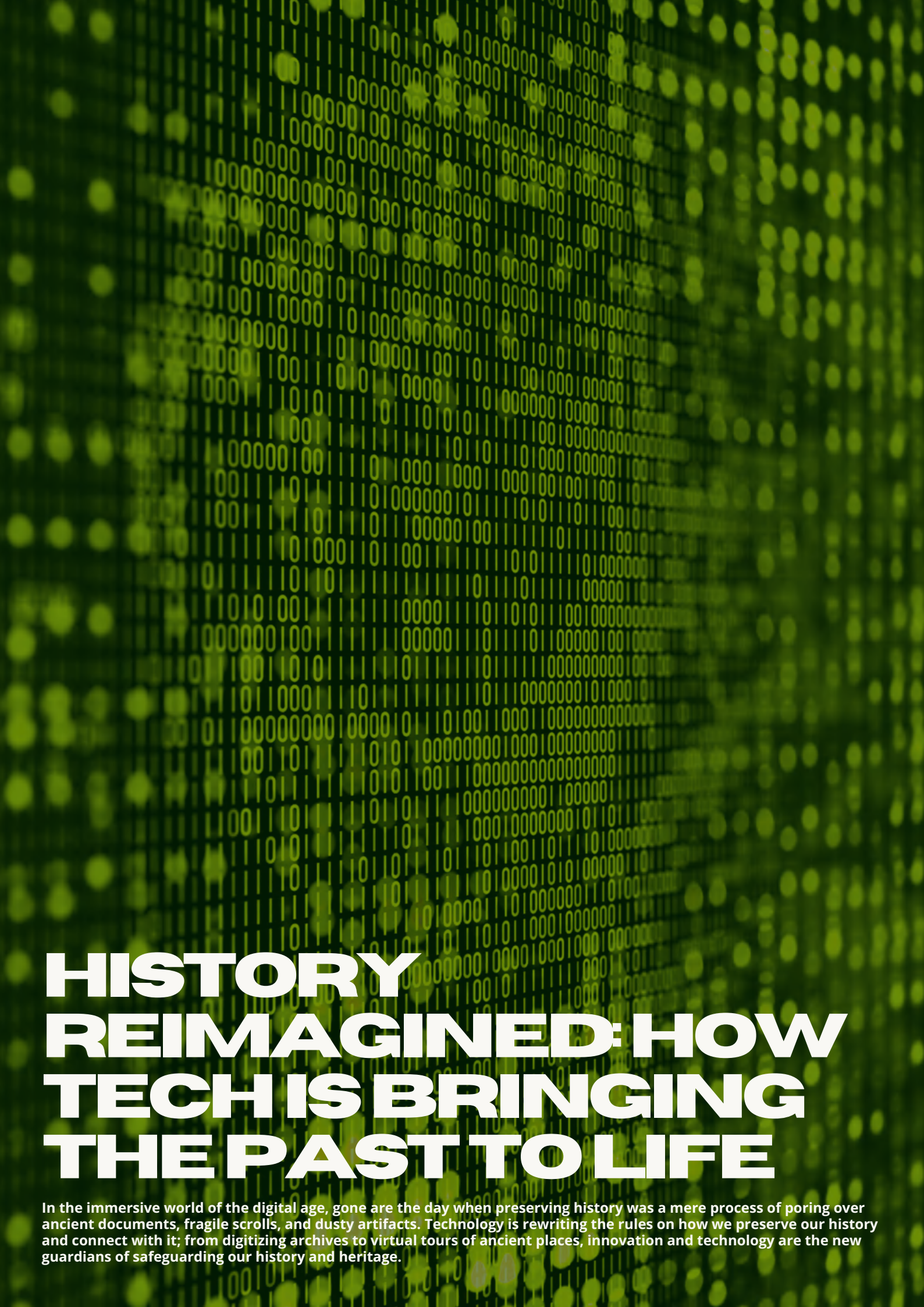
When people analytics is used for decision-making about hiring and promoting workers, biases in the training data or algorithms can cause and perpetuate inequalities. Another criticism is the lack of employees privacy. Extensive use of keyloggers and other monitoring can lead to feelings of constant surveillance, stress, and anxiety. These measure become impossible to escape, especially once people analytics becomes more wide spread. Platform workers are facing the reality of algorithmic control already today

Illusion of Control

On a personal level, self-tracking technologies are pretending to help individuals to take control of their health and wellbeing. Fitness trackers, smartwatches, health apps and alike encourage users to track anything from physical activities and sleep patterns to heart rates and their diets. This constant flow of data should allow individuals to make informed decisions about their lifestyle and health. Yet, goals for weight, heartrate, speed, calorie-intakes and so on are based on societal and algorithmic norms rather than individual needs. The perceived control through self-tracking turns into a mean of subjecting oneself to cultural ideals and algorithms. All to often, the interests of corporations and organizations providing the software are underestimated.

Moving Forward

From optimizing workplace performance to improving personal health: data analysis offers huge opportunities. However, drawbacks and risks cannot be neglected. The reign of numbers comes alongside with biases, breaches of privacy, and corporate interests. Before we submit to the power of data, broader impacts on society and individuals must be considered, ensuring that striving for efficiency does not come at the expense of democracy and humanity.



HISTORY REIMAGINED: HOW TECH IS BRINGING THE PAST TO LIFE

In the immersive world of the digital age, gone are the day when preserving history was a mere process of poring over ancient documents, fragile scrolls, and dusty artifacts. Technology is rewriting the rules on how we preserve our history and connect with it; from digitizing archives to virtual tours of ancient places, innovation and technology are the new guardians of safeguarding our history and heritage.

Digital Archives and Libraries

Have you ever come across a faded photograph or document and wondered about the story it holds? Here, digital archives and libraries come to the rescue. With the help of digital archives and libraries, we can ensure the longevity and accessibility of a vast array of information by digitizing and electronically storing pictures, documents, manuscripts, and even videos! Digital archives are mainly hosted on websites, allowing users to navigate and find what they need easily and efficiently. Removing the need to travel physically to a specific location, users can benefit from interactive features like annotation and comments. Many illustrious institutions, such as the Metropolitan Museum of Art, are leading the change. The Met's digital collection consist of high resolution images of fashion artwork, along with articles and catalogs. With one click of a finger, users can dive into a trove of historical treasures from anywhere in the world – even from the comfort of their living room.

Virtual Reality

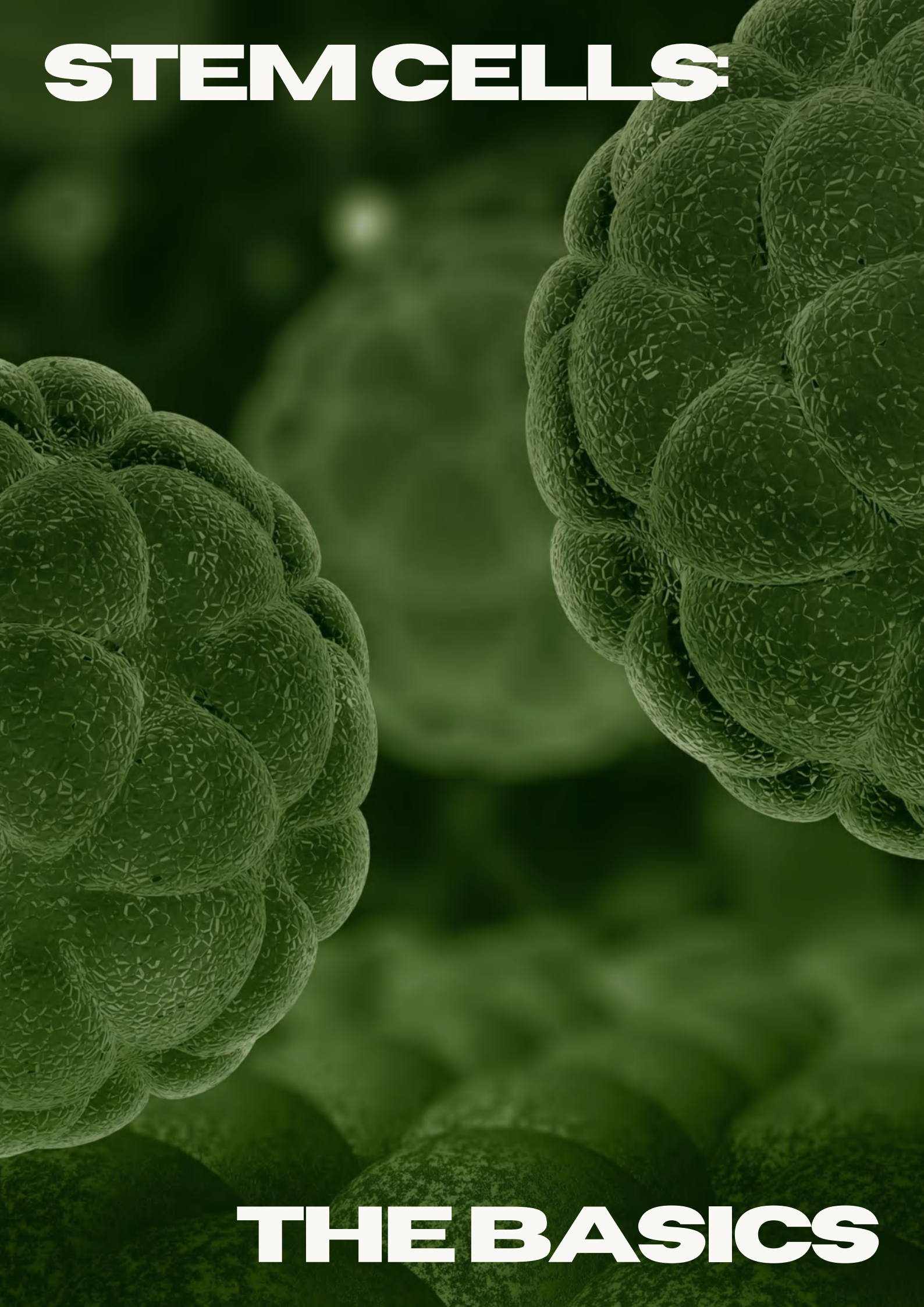
Virtual Reality is transforming the monotonous history classes into time-travelling quests. By digitally reconstructing sites, buildings, and events, VR offers an innovative approach to learning and experiencing the past beyond the heavy history books. With just a pair of VR goggles, users transported to meticulously reconstructed historical sites. You can be a fly witnessing the Great War of Panipat or a wealthy merchant roaming the Turkish Bazaar during the Ottoman Empire -the choice is yours. These virtual environments are digitally constructed with remarkable accuracy, offering insights to the public which are difficult to grasp through textbooks and static displays. Furthermore, it not only provides access to a greater audience, but also safeguards the physical integrity of fragile artifacts from physical wear and tear. By leveraging VR technology, the future generations can experience the stories of their ancestors in a more meaningful way.

With the meticulous digitization of archives, precision of 3D scanning and printing, and the interactive environments created by Virtual Reality, technology is revolutionizing the preservation of history. These advancements not only provides a meaningful experience to learn and study the wonders of history, but also safeguards it for generations to come. As we continue to innovate, the stories and the heritage of our ancestors will be preserved with unprecedented detail and preciseness, allowing us to appreciate our rich heritage and be proud of it.

3D Scanning and Printing

Another wonder of modern technology, 3-Dimensional scanning and printing, has marked a new era in the preservation of ancient artifacts. These technologies aren't just a fantasy; they can produce accurate digital replicas of artifacts, capturing the size, shape, color, and texture of the original objects. These replicas can be analyzed and studied extensively without the risk of damaging the original items. It allows an immersive experience for the researches, who can zoom on the intricate details and study them without the risk of the physical wear and tear of the original. Moreover, any faults in the artifacts can be easily scanned and fixed by 3-D printing the missing parts. The British Museum has scanned numerous artifacts, including the infamous Rosetta Stone, and made the digital replica available to the audience for their studies and researches. Hence, the stories of yesterday are presented and experienced in new ways with the use of innovative technologies, safeguarding the past for the future.

STEM CELLS:



THE BASICS

WHAT ARE STEM CELLS AND WHY ARE THEY IMPORTANT?

Stem cells are like cookie dough that can be turned into many different shapes and flavours of cookies. They can turn into many different types of cells in the body for a variety of reasons, like to regenerate a damaged tissue or in an embryo to develop the baby. They are essential because they help us grow and repair our bodies. Researchers have studied the various types of stem cells and classified them on the basis of their potential, donor source and maturity. The main differentiation potential groups are Totipotent, Pluripotent, Multipotent, Oligopotent and Unipotent. The various types of stem cells on the basis of their maturity are Embryonic, Induced Pluripotent, Adult and Mesenchymal stem cells. The researchers mainly focus on these cell types:

Pluripotent Stem Cells

These can become ANY cell type in the body! They include embryonic stem cells (from early embryos) and induced pluripotent stem cells (iPSCs), which are made by reprogramming adult cells to act like embryonic stem cells. In early embryos, there are two main types of cells: the inner cell mass (which becomes the entire body) and the trophectoderm (which forms the placenta). Scientists learned how to extract and grow stem cells from the inner cell mass of human embryos in 1998. And in 2006, they found a way to reprogram adult cells into pluripotent stem cells (iPSCs), which behave like embryonic stem cells.

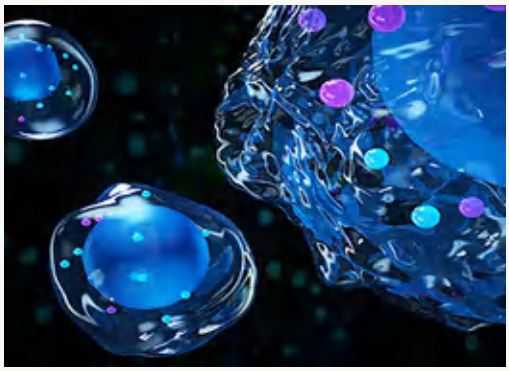
Adult Stem Cells

These are found in specific tissues or organs and help repair and maintain those areas. They can become specialised cells of that tissue or organ.Throughout our lifetime the adult stem cells act as a repair system for the body. They replace cells lost through normal wear and tear, injury, or disease. These cells are found in many organs and tissues and stay inactive until needed.

WHAT MAKES STEM CELLS UNIQUE?

1. Self Renewal

Stem cells can divide and create more stem cells. Unlike muscle, blood, or nerve cells, which don't usually replicate, stem cells can keep producing more cells. Understanding how this process works is extremely crucial for developing new treatments and growing cells in the lab.



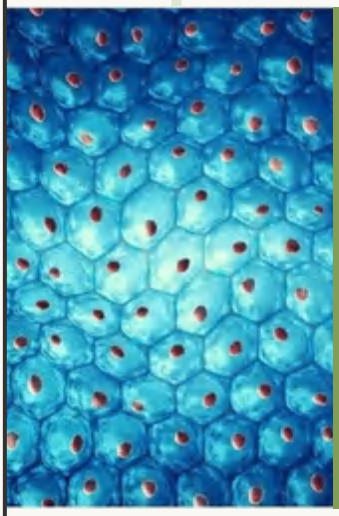
2. Differentiation

Stem cells can become any type of cell in the body. Pluripotent stem cells can turn into any cell type, while adult stem cells specialise in the tissue or organ they are found in. Scientists are learning what signals trigger these changes to better control cell differentiation for therapies.

GROWING STEM CELLS IN THE LAB

How are Stem Cells Grown?

They are grown through **Cell Culture**. Stem cells are grown in lab dishes with a nutrient-rich medium. They attach to the dish, divide, and spread out. When the dish gets crowded, scientists move some cells to new dishes (a process called subculturing). This can go on for months, producing thousands and even millions of stem cells.



How are Regular Cells Reprogrammed?

Scientists can turn regular cells, like skin cells, back into pluripotent stem cells (iPSCs) by forcing them to express specific genes. This process reverses their development, making them versatile again. Isn't that absolutely fascinating!

How are Stem Cells Differentiated?

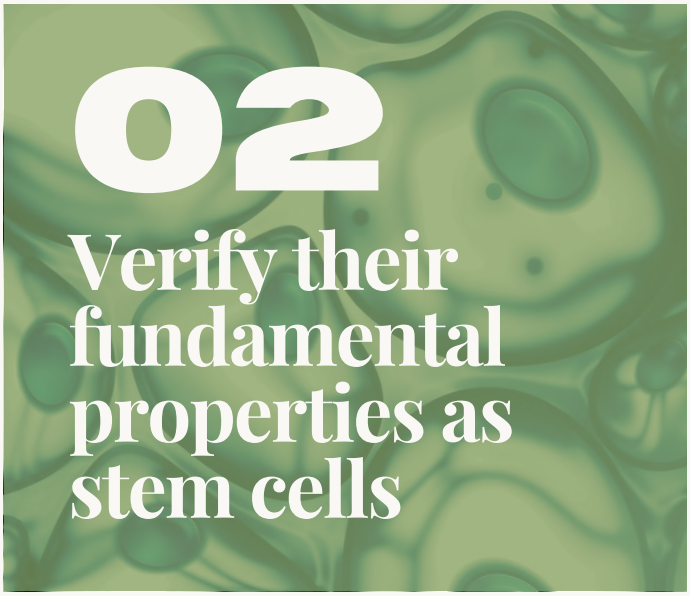
To make stem cells turn into specific types of cells, scientists change the conditions in the culture dish, like the chemicals in the medium or the surface they grow on. They may also modify the cell's genes.

How and Why are Stem Cells Tested?

Scientists test stem cells to ensure they have the right properties. They check gene expression, cell division rates, genome integrity, and the cell's ability to differentiate. They are tested for a variety of reasons such as:

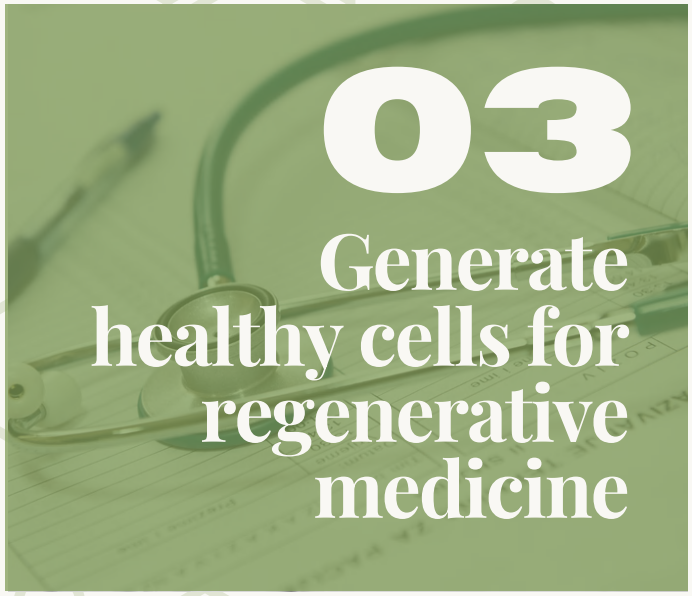
01

Study normal human development and aging



02

Verify their fundamental properties as stem cells

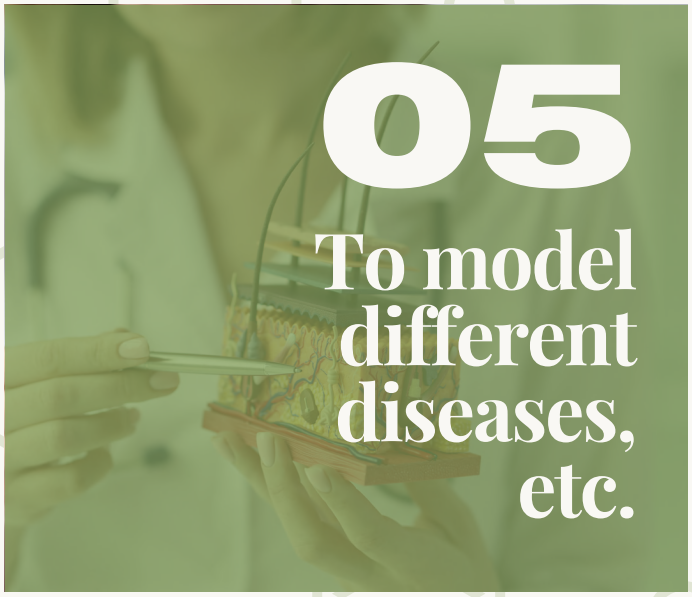


03

Generate healthy cells for regenerative medicine

04

Test new drugs for safety and effectiveness



05

To model different diseases, etc.

HOW ARE STEM CELLS USED IN RESEARCH AND THERAPY?

Understanding Diseases and Testing Drugs

Scientists use stem cells to study how diseases develop and to test new drugs. They can create small models of organs (organoids) or tissue chips from patient-derived iPSCs for personalised research.

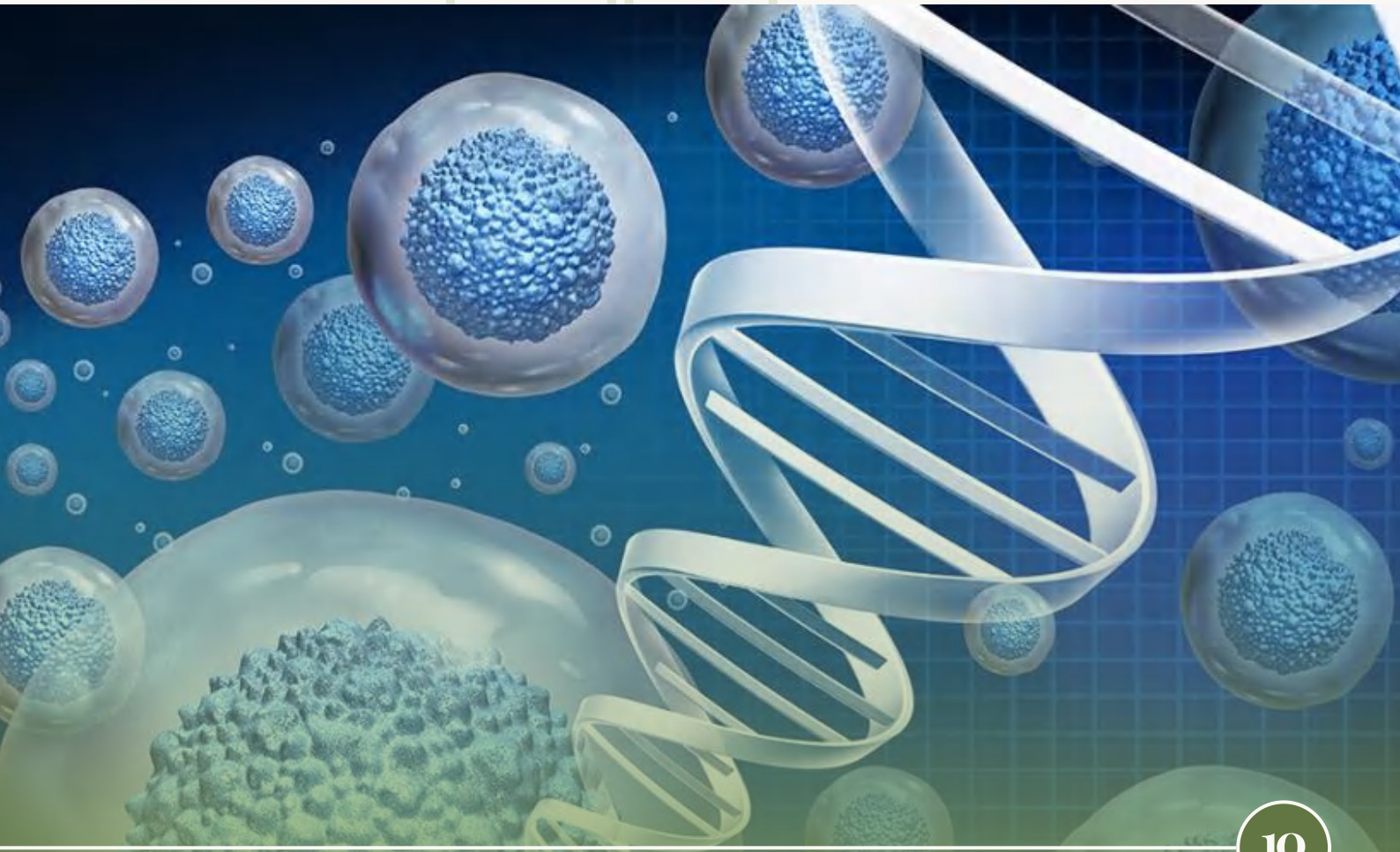
Cell-Based Therapies

Stem cells could be used to generate tissues and organs for transplants. While adult stem cells are limited in number and renewal potential, pluripotent stem cells offer a renewable source. The scientists, though, must ensure these cells can proliferate, differentiate, survive, integrate, avoid rejection, and function properly for successful therapies.

Current FDA-Approved Uses

Currently, the FDA and many other administrations around the world have approved only blood-forming stem cells from cord blood for treating blood-related disorders. Bone marrow is also used for such treatments but isn't regulated by the FDA in the same way.

Stem cells hold great promise for future therapies, but there is still much to learn. The ongoing research is essential to unlock their full potential.



ARE OUR MINDS AT RISK OF BEING REPLACED BY TECHNOLOGY?

As AI evolves, the line between human intellect and machine intelligence becomes increasingly blurred. Once confined to theoretical discussions, AI has now integrated into various aspects of our lives, from education to medicine. AI-powered tools assist in diagnosing diseases, creating websites, driving autonomous vehicles, and curating our social media feeds. According to a survey by Authority Hacker (2024), "72% of companies using AI believe it simplifies their jobs. (Mark Webster)" indicating that a significant number of companies find AI beneficial in their work. With such advancements, one might wonder: are we approaching a future where machines can think and feel for us? In this article, we'll explore how AI-powered machines are becoming smarter, their capabilities compared to humans, and what this means for the future.

Human Mind vs. Artificial Intelligence

The human brain is extraordinarily adaptable. Experiences and emotions can help it learn, memorize, and adapt. They are also capable of critical thought, situation analysis, and innovative problem-solving. This creativity comes from a special combination of feelings, experiences, and mental processes that AI is not yet able to imitate. Individuals are capable of making snap decisions based on a "gut feeling," frequently incorporating a lifetime of experiences. Which makes AI unsuitable for handling social interaction and comprehending human emotions. AI is also unable to comprehend intuition since it cannot conclude past experiences or feelings.

Even with its enhanced powers, artificial intelligence is not conscious or selfaware. It cannot comprehend emotions or ethical issues; instead, it makes decisions based only on data and algorithms. Although AI can be designed to behave morally, it lacks human moral reasoning. Artificial intelligence cannot develop unique art or music; instead, it can produce it by imitating existing genres. This means that AI cannot replicate the creative and inventive processes that are specific to humans.

This distinction means that while AI can support decision-making, it frequently needs human oversight to manage emotions and moral dilemmas.

Neuralink: Bridging the Gap

One of the most innovative developments in this sector is Neuralink, an Elon Musk-founded neurotechnology business. This private company was founded in 2016 and promised that its brain implant would help paraplegics move again and give blind individuals their sight back. Mr. Musk also announced Neuralink's first product, telepathy which will make people capable of using their phone with the aid of their brain.

This shows how technology can replace parts of our brain, improve our physical condition, and enhance our cognitive behavior. Neuralink is a prime example of how technology may augment rather than replace our minds by adding new functions and improving our innate skills.

Future Advancements in AI

AI may grow even more intelligent and beneficial in the future. It may be able to converse with humans intelligibly and human-like. AI could make learning more enjoyable and individualized for children. AI could help physicians diagnose and treat patients more rapidly. Self-driving vehicles may get more popular and safer. AI may also facilitate the creation of stories, music, and other artistic works, enhancing the creative process.

Conclusion

Although artificial intelligence (AI) and cutting-edge technologies like Neuralink are revolutionizing human cognition and talents, the human mind still possesses unique traits like creativity, intuition, and emotional intelligence. Instead of replacing human intelligence, these technologies are more likely to strengthen and augment it, paving the way for a time when AI and humans collaborate to accomplish amazing feats.

DIGITAL ADDITION

Logic Gates

History

Leibniz, in 1705, published the binary number system, which laid the foundations to digital arithmetic and logic. Later, Peirce first described the idea of electrical circuitry carrying out operations in an 1886 letter. Here, logic gates are an abstraction of a collection of MOS FETs. We also will omit power and ground connections, which typically should be part of a logic gate.

Asymptomatic Notation

It is arguable both ways as to how much exactly a gate delay is, and it is often cumbersome to decide between n^2 gate delays and $n^2 - 1$ gate delays. Therefore, we'll use asymptotic notation and denote both as $\Theta(n^2)$.

Definition 4.1. Define $f(n) \quad \Theta(g(n))$, if and only if there exists positive constants c_1 and c_2 such that there is a k satisfying $f(x) < c_1 g(x)$ and $c_2 g(x) < f(x)$ for all $x > k$.

Example 4.2. Consider $g(n) = 2^n$. $g(n) \quad \Theta(g(n+1))$, since we can set $c_1 = 3$ and $c_2 = 1$. However, $g(n)/ \quad \Theta(g(2n))$ since we can set $x = \max\{\log_2(c_1), k + 1\}$.

Theorem 4.3. If $f(n) \quad \Theta(F(n))$ and $g(n) \quad \Theta(G(n))$, then $f(n) + g(n) \quad \Theta(F(n) + G(n))$ and $f(n) \cdot g(n) \quad \Theta(F(n) \cdot G(n))$.

Proof. Let the constants for $f(n) \quad \Theta(F(n))$ be f_1, f_2, and f_k, and the constants for the other one be similarly g_1, g_2, and g_k. Taking $c_1 = \max\{f_1, g_1\}$, $c_2 = \min\{f_2, g_2\}$, and $k = \max\{f_k, g_k\}$ solves both statements.

Asymptotic Notation will prove to be essential when analyzing different ways to implementing addition using logic gates.

Symbolic Representation

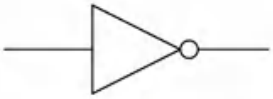


Figure 15: NOT gate

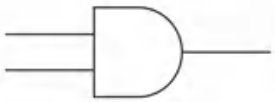


Figure 16: AND gate

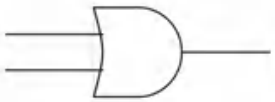


Figure 17: OR gate

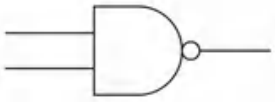


Figure 18: NAND gate

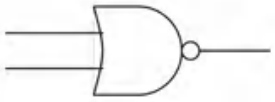


Figure 19: NOR gate

The figures above shows the NOT, AND, and OR logic gates. Adding a circle to the right of a gate inverts the signal.

Usage

Here is an XOR gate made up of these fundamental circuits:

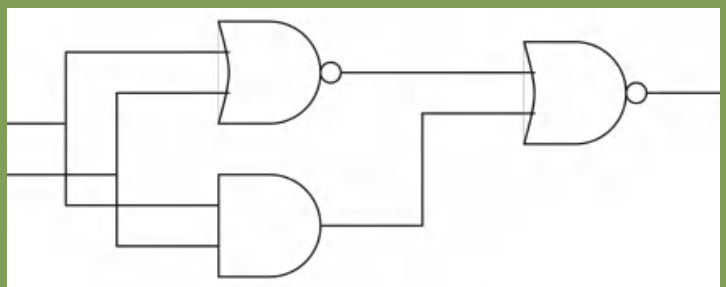


Figure 20: XOR gate

There are two things we can analyze about the configuration: the time it consumes and the space it consumes. The space it consumes can be thought of as simply the number of logic gates it has, but the time is a little harder to analyze.

Consider the critical path to be the path of longest delay from input to output. [20] One of the critical paths of the XOR gate is highlighted in red:

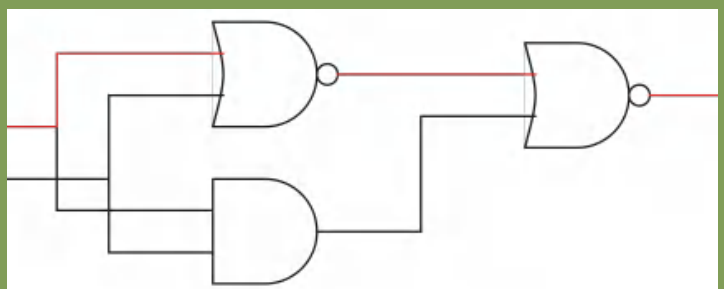


Figure 21: Critical Path

Counting the number of logic gates on that route yields 2 gate delays.

Full Adders

Composition

Each half adders adds two numbers to create a sum bit and a carry bit, representing the sum of the two inputs. (Figure 22)

Input 1	Input 2	Carry	Sum
0	0	0	0
0	1	0	1
1	0	0	1
1	1	1	0

Figure 22: Truth Table for Half Adder

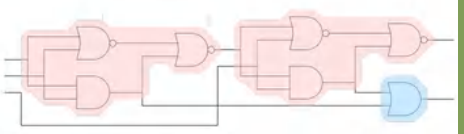


Figure 23: A Full Adder composed of two Half Adders

In Figure 23, the red outlines show two half adders chained together that have an OR gate connecting the outputs. This produces a Full Adder. (Figure 24)

Input 1	Input 2	Input 3	Carry	Sum
0	0	0	0	0
0	0	1	0	1
0	1	0	0	1
0	1	1	1	0
1	0	0	0	1
1	0	1	1	0
1	1	0	1	0
1	1	1	1	1

Figure 24: Truth Table for Full Adder

It is trivial to reach the conclusion that both adders takes Θ(1) time.

Usage

Suppose we wanted to add longer integers. The easiest way is to chain together multiple Full Adders. Figure 25 demonstrates a 4-bit adder computing 11 + 13 = 24. (The red wires are high, while the grey wires are low.)

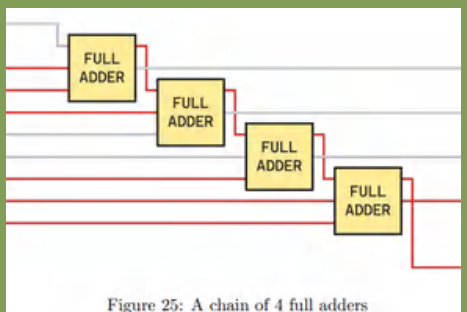


Figure 25: A chain of 4 full adders

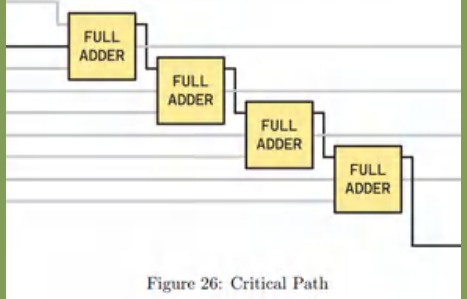


Figure 26: Critical Path

This way takes Θ(n) space and Θ(n) time, where n is the number of bits we wish to add. Later, we will look at schemes to optimize this time.

This is called the Ripple Carry Adder, since the carry ripples across each full adder in the worst case:

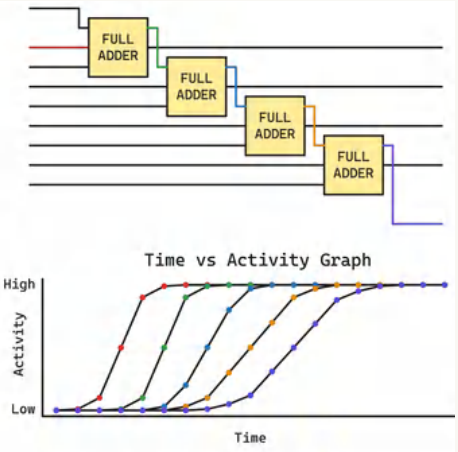


Figure 27: Note that this is a simplified representation.

(Note that often times a buffer is added to the end to standardize the input, which we have omitted. Additionally, the effect of inaccuracies in the logic gates are exaggerated.)

Carry Select Adder

Currently, what we have is n full adders chained together to create an n-bit adder:

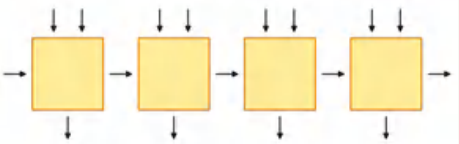


Figure 28: Ripple Carry Adder

Suppose we can split the work among k people, such that each person computes n/k bits of the sum:

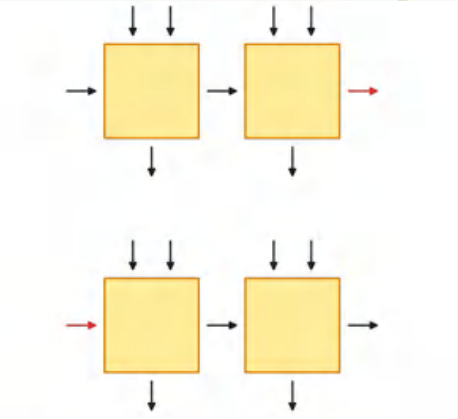


Figure 29: k people working simultaneously

Although this means that the calculation can proceed parallel, the two red arrows are dependent. That is, the second person depends on the result of the first person.

This is analogous to reporters reporting on an event. There are, say, two likely results of an event, and the reporter would like to report on it as soon as possible. Instead of waiting for the event to conclude, the reporter can simply draft up both versions beforehand and then select one.

In our scenario, the second person can carry out both possibilities of the carry in at the same time and then use a multiplexer to select the one needed.

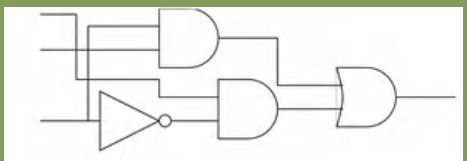


Figure 30: MUX Gate

Here is a multiplexer:

Input 1	Input 2	Selector	Output
0	0	0	0
0	0	1	0
0	1	0	0
0	1	1	1
1	0	0	1
1	0	1	0
1	1	0	1
1	1	1	1

Figure 31: Truth Table for a Multiplexer

Using n/2 MUX gates, we can create an n/2 bit MUX. Therefore, an adder could look like this:

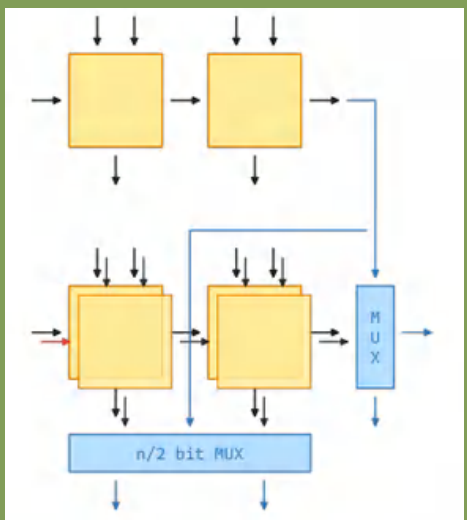


Figure 32: a 4 bit adder

Extending to 16 bits, it would be:

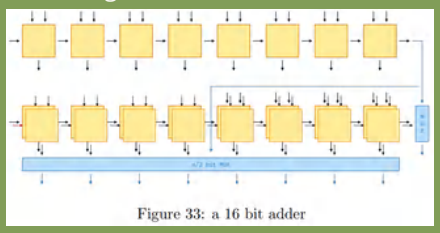


Figure 33: a 16 bit adder

This has Θ(n) time complexity, since you simply halved the time, but it does no effect asymptotically.

However, by getting k people instead of just 2, we can optimize this further.

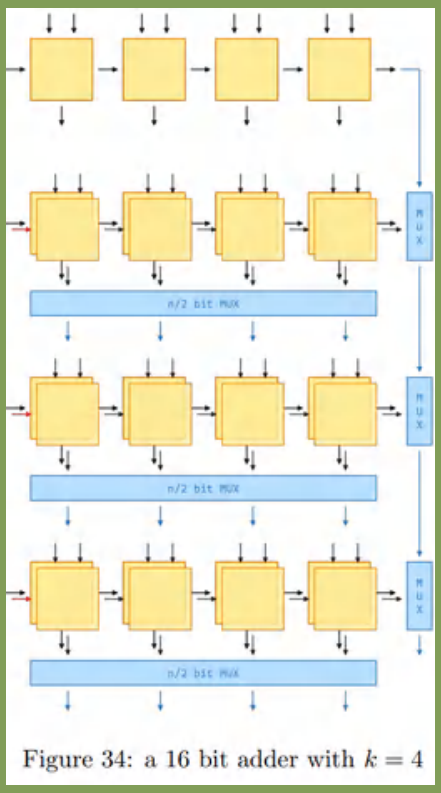


Figure 34: a 16 bit adder with $k = 4$

Setting k = Θ(√ n) yields the time complexity of Θ(√ n). Note that the space used is asymptotically equal to two sets of ripple carry adders, so it is still Θ(n), although it is twice as big.

However, we can improve beyond that.

Using divide and conquer, we can divide each problem into smaller subproblems until they become trivial.

Figure 35: Binary Tree subdivisions

Except here, we actually have to create replicas of each sub-problem to feed through a multiplexer:

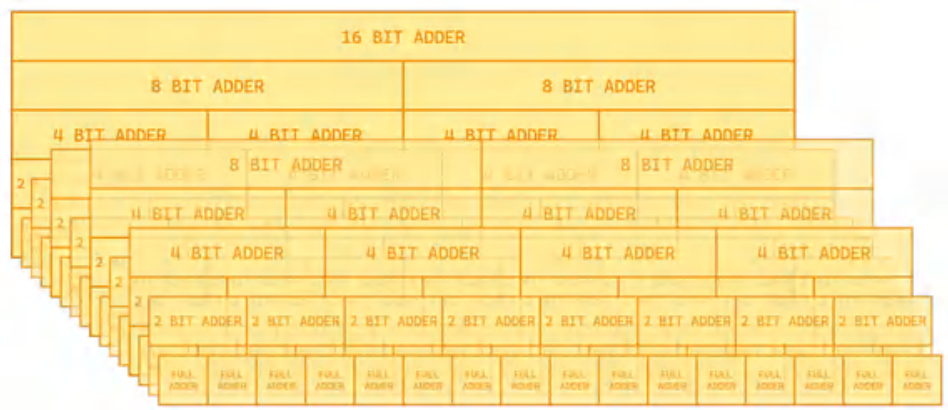


Figure 36: Tree-like structure of subdivisions

Since for an n-bit adder, we compute 4 n/2-bit adders simultaneously and then select the output, we have the recurrence relation:

$$T(n) = T(n/2) + \Theta(1)$$

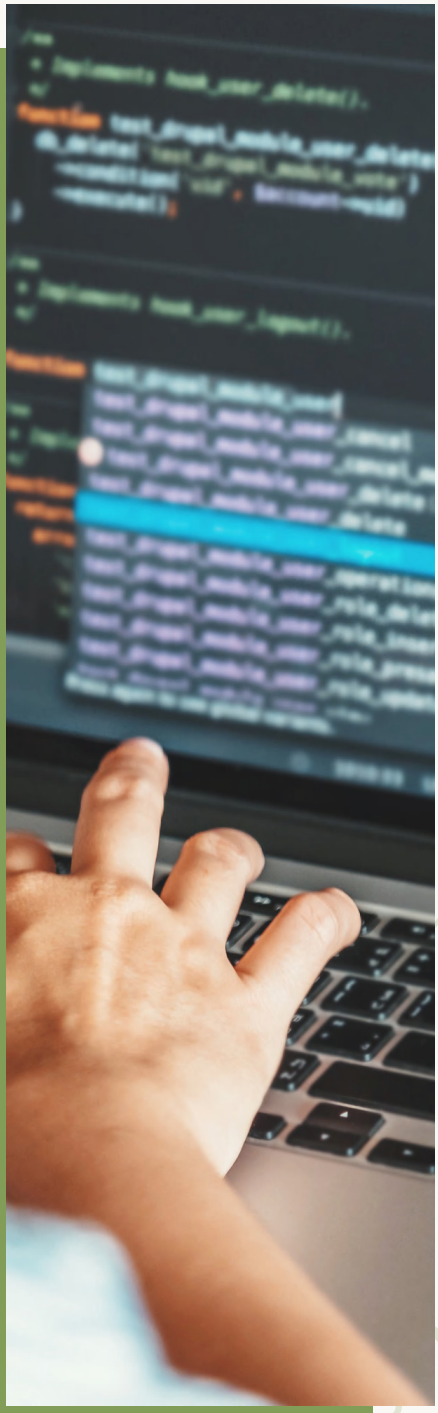
which easily resolves to T(n) = Θ(log n). (As an overkill, you can apply Master Theorem.

What about the space? Since an n-bit adder requires 4 n/2-bit adders and an n-bit multiplexer, we have:

$$T(n) = 4T(n/2) + \Theta(n)$$

Invoking Master Theorem, the recurrence relation simplifies to $\Theta(n^2)$. This gives it a significant disadvantage.

SPARROW: THE MOST PROMISING ALGORITHM OF THE CENTURY?



We are now in an age where AI is increasingly indispensable to humanity and several of our most important industries, yet seemingly it still remains synonymous with the likes of Chat-GPT and copilot. At the cutting edge intersection of pharmaceuticals and computer science, MIT researchers have crafted an algorithm designed to identify the most promising molecular candidates for new medicines, effectively streamlining the drug discovery process. This tool, named the Synthesis Planning and Rewards-based Route Optimization Workflow (SPARROW), leverages AI to navigate through the complex landscape of variables that often impedes the development of new medications.

The compounds for drug development are complex to prioritise due to the effective weighting of several variables. SPARROW, like many other algorithms, identifies accurately the best molecules to test as potential new medicines. However what sets it apart is the ability to identify the materials and experimental steps needed to synthesise them while considering the cost of synthesising multiple molecules at once, as multiple candidates can be derived from some of the same chemical compounds.

In addition, the approach captures crucial information on molecular design, property prediction and synthesis planning from online repositories and widely used artificial intelligence tools. When evaluated across three case studies based on real-world problems faced by chemists, SPARROW effectively captured the marginal costs of batch synthesis and identified common experimental steps and intermediate chemicals, as well as scaling up hundreds of potential molecular candidates. SPARROW collects information on the molecules and their synthetic pathways, weighs the value of each one against the cost of synthesising a batch of candidates and automatically selects the best subset that meets the user's criteria by finding the most cost-effective synthetic routes for these compounds.

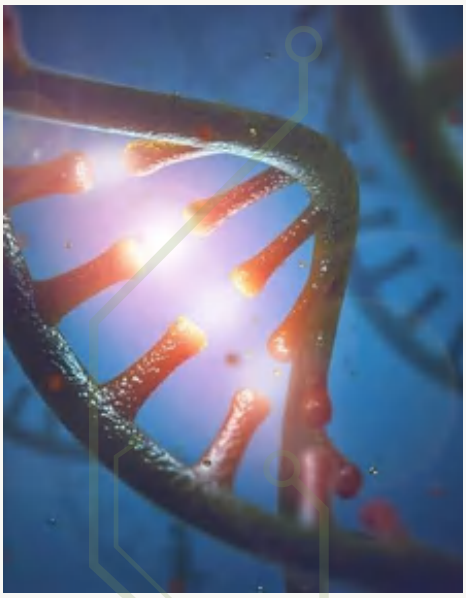
Researchers at MIT (C. Coley, J. Fromer) have stated that the key challenge in each design iteration is to downselect and prioritise, among all possible molecules that could be made and tested, which candidates are worth pursuing. This challenge exists across molecular design applications, including in the discovery of therapeutic candidates, organic catalysts, battery materials, and sustainable solvents.

So let's cut the technical jargon, in simple english, SPARROW can find a compromise by accurately weighing the cost of making the product to the potential efficiency of the molecule, saving time and money in further research and development processes. Sounds simple, but what are the impacts that this program brings?

With continued development, the SPARROW framework promises a smarter, more systematic method for drug discovery, by not only accelerating the process but also potentially reducing prescription drug prices—a boon for both the pharmaceutical industry and cwith onsumers. Experts outside of the study, like Patrick Riley and John Chodera, recognized the value of SPARROW in relieving the workload of medicinal chemists and contributing to more autonomous drug discovery methods. As noted by MIT News, this research also received support from entities such as DARPA, the Office of Naval Research, and the National Science Foundation, highlighting the broader interest and advancements in AI applications across disciplines.

ANTISENSE TECHNOLOGY

Revolutionizing Gene Therapy



Imagine your body's cells are tiny factories that produce different products, such as proteins, which are essential for your health. The instructions for making these proteins are stored in your DNA. When a certain protein needs to be made, the DNA instructions are copied into a molecule called messenger RNA ,AKA the mRNA. This then travels to the factory of the cell (which is the ribosome) where the protein is made.

Now here is where the Antisense technology is involved. It is a tool used to create short, synthetic pieces of DNA or RNA, called antisense oligonucleotides (ASOs).These are designed to bind to the mRNA instructions. By Doing so, these antisense molecules can block the production of certain proteins. This can be useful in situations where a specific protein is causing a problem, such as in some genetic diseases, cancers, or viral infections.

For example, if a particular protein is promoting cancer growth, an antisense oligonucleotide can be designed to bind to the mRNA of that protein. This prevents it from being made and thereby helping to stop the cancer from growing.

Antisense technology is leading the charge in genetic medicine, offering a fresh approach to tackle various illnesses by honing in on the genetic instructions in our cells.

Therapeutic Breakthroughs

One super exciting thing about antisense technology is its potential for battling genetic disorders. Dr. C. Frank Bennett's review titled "Therapeutic Antisense Oligonucleotides Are Coming of Age" strides through the evolution of this tech. Bennett highlights that ASOs have moved from being a theoretical concept to having real-world applications, with several antisense drugs now greenlit for clinical use. These drugs are in use for various genetic disorders like spinal muscular atrophy and Duchenne muscular dystrophy, proving how flexible and effective antisense therapies can be.

In-Cell Chit-Chats

The success of antisense tech also leans on how ASOs mingle with components within cells. The project by Liang et al., "Identification and characterization of intracellular proteins that bind oligonucleotides with phosphorothioate linkages," dives into these interactions. Liang and his team pinpointed several proteins inside cells that bond with ASOs sporting phosphorothioate tweaks - a common chemical move used to amp up ASO stability. Grasping these bonds helps create more effective ASOs and predict their actions within cells is key when crafting safer, more potent therapies.

Trading & Bio

For antisense tech to shine, understanding how ASOs behave inside your body is key. The work by R. Geary, D. Norris, etc., "Pharmacokinetics, biodistribution and cell uptake of antisense oligonucleotides," dives into these crucial factors. This study peeps into how ASOs spread all over your body, how cells slurp them up, and how long they hang around in different tissues. This intel is vital for fine-tuning the delivery and impact of antisense drugs, ensuring they reach target cells in just-right amounts to do their job.

Futuristic Antisense Wonders

Advances in antisense tech point toward a bright future for gene therapy. By laser-focusing on genetic disease roots, antisense oligonucleotides offer a potent weapon against previously challenging conditions. Ongoing research continues to polish these molecules, enhance delivery methods, and broaden therapeutic uses. As our grasp on genetic diseases deepens and our knack for tweaking gene expression evolves, antisense technology is geared up for a starring role in modern medicine.

Takeaway

In conclusion, antisense technology is flipping the script on how we tackle genetic disorders. With its precision targeting and gene modulation chops, it offers fresh hope for patients dealing with various conditions. The research contributions from scientists like Bennett, Geary, and Liang are shaping the path toward next-gen genetic therapies - inching us closer to a future where managing if not curing genetic diseases becomes reality."

OVERCOMING STEREOTYPES FOR WOMEN IN STEM

Introduction

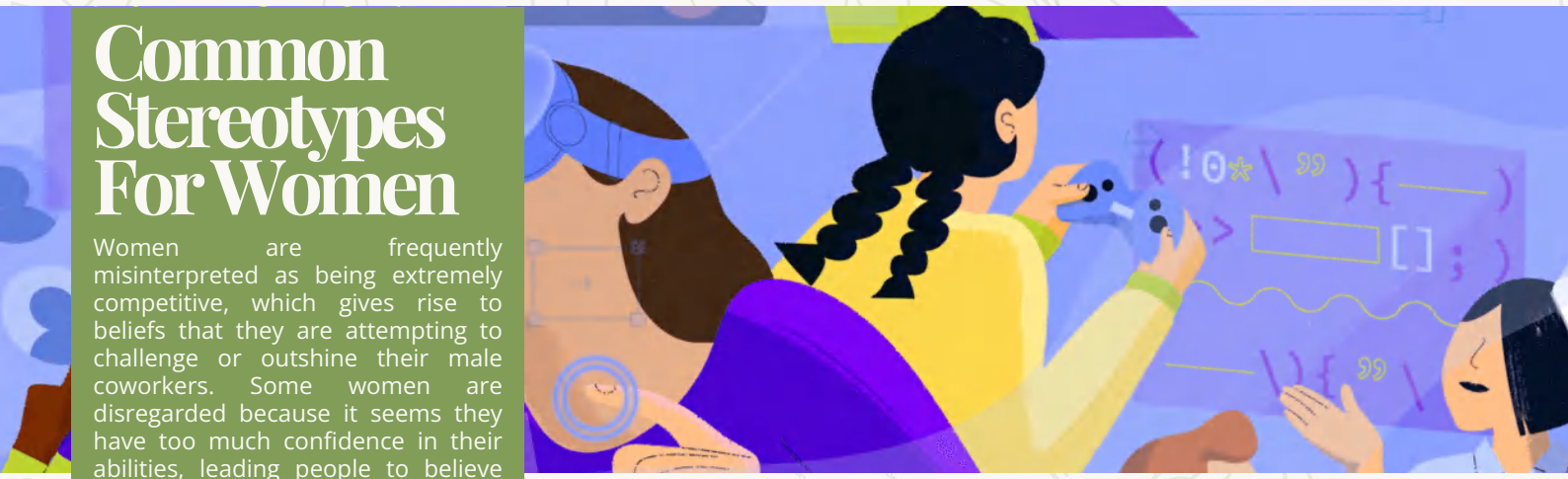
It is no longer shocking that women are consistently undervalued in a variety of fields. Despite continuously exhibiting their full talent, they are unfairly judged. Every woman I know aspires to be better and endures in the face of adversity, especially those in STEM professions. Women in STEM continue to be denied respect despite overcoming many challenges and consistently demonstrating their ability. This problem is mostly caused by a male-dominated social structure that supports the idea that women are not capable of accomplishing the same objectives as men. Women thus experience discrimination at work, receive little credit for their efforts, and run into difficulties when speaking out for themselves. Unfortunately, a lot of well-known organizations reduce women to stereotypes by dismissing them as inexperienced, unreliable, and under-competitive. Women should be aware of the harsh reality of prejudice they will probably face before pursuing careers in STEM or any other profession, as this will create an unfair and difficult work environment.

Role models in STEM

The success of antisense tech also leans on how ASOs mingle with components within cells. The project by Liang et al., "Identification and characterization of intracellular proteins that bind oligonucleotides with phosphorothioate linkages," dives into these interactions. Liang and his team pinpointed several proteins inside cells that bond with ASOs sporting phosphorothioate tweaks - a common chemical move used to amp up ASO stability. Grasping these bonds helps create more effective ASOs and predict their actions within cells is key when crafting safer, more potent therapies.

Common Stereotypes For Women

Women are frequently misinterpreted as being extremely competitive, which gives rise to beliefs that they are attempting to challenge or outshine their male coworkers. Some women are disregarded because it seems they have too much confidence in their abilities, leading people to believe they are inexperienced. In addition, women are sometimes written off as being unintelligent and unclear-headed, purportedly due to their preoccupation with domestic tasks and issues. They are often excluded from leadership posts because they are viewed as insufficiently qualified for them. In addition, women are seldom given priority for critical jobs at work and typically earn less money than their male coworkers.



Strategies for Change

The purpose of mentoring programs should be to empower women by increasing their self-assurance and ability to withstand discrimination in the workplace. Policies that promote effective collaboration between men and women should be put in place to create a healthy work environment. It is important to support STEM organization leaders in their efforts to encourage young females to pursue STEM-related education and employment. Lastly, women in STEM should be celebrated and respected equally.

ANXIETY: A BIOLOGICAL PERSPECTIVE

Anxiety is one of the prevalent psychiatric disorders among the youth, significantly compromising an individual's quality of life, relationships and well being. It is described as persistent feelings of apprehension and worry. This article aims to dive into the biological factors that contribute to depression disorders, limited to genetic, endocrine and neurotransmitter systems as well as certain brain areas associated with anxiety, in order to enhance their understanding among young people and aid them in seeking effective interventions to improve their mental health.

Hormones

Cortisol

Cortisol is a steroid hormone released during stress. Elevated cortisol levels in the body damages brain areas such as the hippocampus which further exacerbates depression. It also slows down metabolism and weakens immunity thus inhibiting an individual's ability to function and perform well in academic and practical aspects of life

Epinephrine

Epinephrine is released in response to acute stress and fear. It is the "fight or flight" hormone. It causes symptoms such as rapid heart rate, erratic breathing, trembling, dizziness and perspiration, which can also be characterized as physical symptoms of depression. Prolonged or frequent release of this hormone can be damaging to a person's mental and physical health and also increases risk of heart disease.

Neurotransmitters

Serotonin

Serotonin is a neurotransmitter that regulates mood, sleep and appetite. Decreased serotonergic activity results in . People with imbalances in serotonin levels are more prone to impulsive actions, agitation, fatigue, insomnia as well as trouble with memory and learning.

Dopamine

Dopamine is a hormone and a neurotransmitter that contributes to feelings of happiness, motivation and focus. It is often referred to as the "feel good hormone". Dysregulation in dopamine levels causes several symptoms of depression and depression including fatigue, sudden mood swings and brain fog.

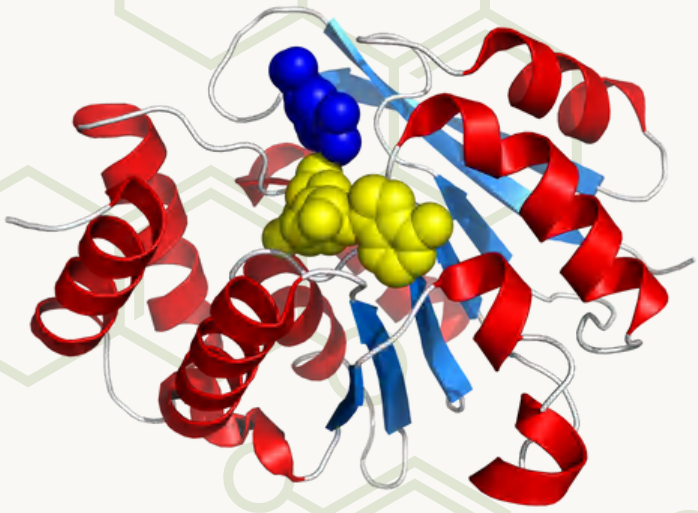
Specific Genetic Variations

Serotonin transporter gene (5-HTTLPR)

The serotonin transporter (SERT) regulates serotonin signaling by rapidly transporting extracellular serotonin into the presynaptic terminal. The short allele of this gene can pose a higher risk of developing depression. Individuals carrying this gene interpret and understand information in a pessimistic manner and can be perceived as negative or cynical.

COMT gene

The COMT gene codes for an enzyme COMT that breaks down the catecholamines (dopamine, epinephrine and norepinephrine). Mutations in this gene can cause imbalances in dopamine and epinephrine levels. These can have adverse effects on the stress levels and emotional responses of individuals leading to the development of anxiety.



Brain Structures

Prefrontal Cortex

This region is responsible for higher cognitive functions such as decision-making, judgment and planning. The PFC plays a pivotal role in regulating emotions by modulating activity in the amygdala. Failure to do so can lead to anxiety and fear. Dysfunction in this area also increases the tendency to overthink or ruminate on potential negative outcomes.

Amygdala

The amygdala is involved in the expression of fear and aggression. It plays a role in the formation and retrieval of emotional and fear-related memories. Larger amygdala volumes are associated with depression. Overactive amygdala causes intense emotional responses and causes the individual to panic.

Hippocampus

Hippocampus regulates stress responses and transfers short term memories to long term memories. People with anxiety and other stress disorders have reduced hippocampal volume and density as shown by structural imaging studies. A smaller hippocampus might result in disturbance of the hypothalamic-pituitary-adrenal (HPA) axis, which controls the release of stress hormones like cortisol. This dysregulation can cause elevated anxiety levels.

Conclusion

Usually, when people address anxiety, they are most likely to say “it’s all in your head.” However, neuroscience research studies show that there are various aspects to anxiety and consider it a serious disorder. Young people with anxiety should not be humiliated by this condition but rather feel heartened to seek therapy and medications.

ILLUMINATING PATHWAYS

Empowering Future Generations Through Eco-Literacy

Abstract

Climatic change is a global phenomenon. It looms as one of the greatest challenges of our time, threatening the very foundation of life on Earth. In the midst, of the fight against is where eco-literacy seems to take the lead of bold action. Eco-literacy is among the most powerful tools to fight climatic change. Enhancing Eco-literacy by incorporating emerging technologies, social media and integration into the curriculum can unlock new pathways towards sustainability and resilience.

Keywords: Climatic change, eco-literacy, tool and sustainability

Introduction

In the vast of human existence, there exists a thread that binds us all – the intricate relationship between humanity and the environment. This delicate interplay has endured through millennia, shaping cultures, economies, and ecosystems. However, in our modern era, this relationship has become strained, frayed by the consequences of our unsustainable actions. Climate change looms as one of the greatest challenges of our time, threatening the very foundation of life on Earth. Climate change is arguably the major environmental challenge for future economic or GDP growth, since climate damages are predicted to generate substantial economic costs and stringent climate policies may curtail growth (van den Bergh, 2017). Yet, within this challenge lies an opportunity – an opportunity to cultivate eco-literacy, to empower future generations with the knowledge and understanding needed to navigate the complexities of our changing world.

The Urgency of Eco-Literacy

Eco-literacy is more than just an understanding of ecological principles; it is a holistic perspective that encompasses environmental awareness, sustainability practices, and a sense of interconnectedness with the natural world. Eco-literacy entails acquiring knowledge about the interconnectedness between humans and the natural world, including floras, faunas, and geological formations (Abdullah, K. H. 2023). In the face of climate change, eco-literacy emerges as a beacon of hope, offering a pathway towards resilience and adaptation. By equipping individuals with the knowledge and skills to address environmental challenges, we can foster a culture of stewardship and collective action.

The Role of Education

Central to the cultivation of eco-literacy is education – education that transcends the boundaries of traditional classroom settings and embraces experiential learning, critical thinking, and interdisciplinary approaches. Nelson Mandela said ‘education is among the tools to change the world’, in my opinion eco-literacy is the most powerful tool to fight against climate change. It is through education that we can instill in future generations a deep appreciation for the environment and empower them to become agents of change. From early childhood through adulthood, eco-literacy must be woven into the fabric of education, shaping curricula, pedagogies, and learning environments to reflect our interconnectedness with the natural world.

Innovative Approaches

To truly unleash the transformative power of eco-literacy, we must embrace innovative approaches that engage, inspire, and empower. This includes:

1. Leveraging emerging cheap technologies

To create immersive learning experiences, harnessing the arts to evoke emotional connections with nature, and fostering partnerships between schools, communities, and environmental organizations. Emerging technologies where users embark on virtual journeys to explore different ecosystems, learn about environmental issues, and take action to make a positive impact are required. These technologies work like this:

Virtual Eco-Adventures: Users can choose from a variety of virtual eco-adventures, such as exploring the Amazon rainforest, diving into coral reefs, or trekking through Arctic tundra. These adventures are presented as immersive 3D experiences, allowing users to virtually "travel" to different locations around the world.

Interactive Learning Modules: Along the way, users encounter interactive learning modules that educate them about various environmental topics, such as biodiversity, climate change, sustainable living, and conservation efforts. These modules incorporate multimedia elements, including videos, infographics, quizzes, and mini-games, to make learning fun and engaging.

Challenges and Missions: To encourage active participation, users can take on challenges and missions related to eco-literacy. For example, they may be tasked with identifying plant and animal species, calculating carbon footprints, or creating eco-friendly lifestyle plans. Completing challenges earns users points, badges, and rewards.

Community Engagement: The technologies foster a sense of community by allowing users to connect with like-minded individuals, join virtual eco-groups, and participate in discussions about environmental issues. Users can share their experiences, insights, and achievements with others, inspiring and empowering each other to take action for the planet.

Real-World Impact: To translate virtual learning into real-world impact, the technologies partner with environmental organizations and initiatives. Users can support conservation projects, donate to causes, participate in volunteer opportunities, and track their contributions through the app. This gamified approach to eco-activism motivates users to make tangible differences in the world around them.

Data Collection and Analysis: These technologies also serve as a valuable tool for data collection and analysis. Through user-generated content and feedback, the app gathers insights into environmental awareness, attitudes, and behaviors. This data can be used to inform research, advocacy campaigns, and policy interventions aimed at promoting eco-literacy and sustainability.

By more leveraging cheap emerging technologies to transform eco-literacy into an engaging and accessible experience for users of all ages will inspires a new generation of environmental stewards who are informed, empowered, and ready to take on the challenges of a changing planet.

2. Social Media

Social media platforms' proliferation and widespread adoption in contemporary digital landscapes have substantially transformed how individuals establish connections, communicate, and obtain information (Masele JJ.2021). The connection of social media and eco-literacy has given rise to a captivating field wherein their convergence is to be acknowledged. Social media has provided a wider room to enhance eco-literacy among the public achieved by utilizing innovative communication strategies that place audience engagement as a top priority. Examples of such systems include immersive journalism and the creation of promotional content within metaverse platforms (Hui X, 2023). Social media like Twitter, Facebook, Whatsapp, Instagram etc. has become our part of life where we not only access to entertainment but also educational information to. Utilizing these platforms will not only enhance eco-literacy but also consciousness of emerging environmental issues.

3. Eco-Literacy Into Curriculum

Many countries like Nigeria have failed to incorporate qualitative eco-literacy education into their curriculum. Eco-literacy has been considered a sub-topic under ecology in biology in many country curriculums. Attempt has been made by examination board like West Africa Examination Board to ensure active knowledge of high school student to know about eco-literacy, but this has not seen to people of all ages. Rather than this, the education board in each country should enforce.

Modular Curriculum: to offers a modular curriculum framework that can be adapted to different age groups and educational settings, including schools, community centers, and online platforms. Each module is designed to cover key environmental topics, such as biodiversity, climate change, conservation, sustainable living, and environmental justice.

Interactive Learning Experiences: Rather than relying solely on traditional textbooks and lectures, they should provide interactive learning experiences that engage learners through multimedia content, hands-on activities, simulations, virtual field trips, and gamified challenges. These experiences cater to diverse learning styles and foster active participation and critical thinking.

Cross-Curricular Integration: to promotes cross-curricular integration by connecting eco-literacy with other subject areas, such as science, social studies, language arts, mathematics, and the arts. This interdisciplinary approach helps learners make connections between environmental issues and real-world contexts, fostering a deeper understanding of the interconnectedness of the natural world.

Lifelong Learning Pathways: to offers lifelong learning pathways that accommodate learners at different stages of life, from early childhood through adulthood. For example, there are modules tailored specifically for preschoolers, elementary school students, teenagers, adults, and seniors, each addressing age-appropriate concepts and skills.

Community Engagement and Action: to emphasizes community engagement and action by encouraging learners to apply their eco-literacy knowledge and skills to real-world challenges and opportunities in their local communities. This may involve citizen science projects, environmental monitoring initiatives, community gardens, advocacy campaigns, and sustainability projects.

Organizing competitions is an excellent way to promote eco-literacy across all age groups and foster engagement, creativity, and collaboration. Here's how competitions can be incorporated into eco-literacy initiatives:

Green School Competitions

Eco-literacy is more than just an understanding of ecological principles; it is a holistic perspective that encompasses environmental awareness, sustainability practices, and a sense of interconnectedness with the natural world. Eco-literacy entails acquiring knowledge about the interconnectedness between humans and the natural world, including floras, faunas, and geological formations (Abdullah, K. H. 2023). In the face of

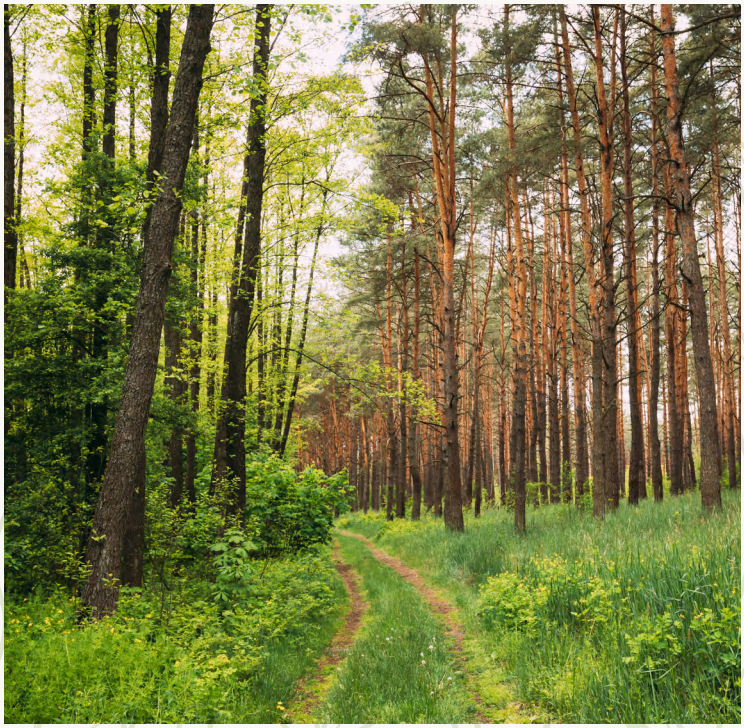
Eco-Innovation Challenges

Organize competitions that encourage participants to develop innovative solutions to environmental challenges. These challenges could focus on designing eco-friendly products, implementing sustainable technologies, or creating community-based initiatives to address issues like waste management, energy conservation, or water pollution.

Youth Debates: Environmental Policies

Organize debates or mock legislative sessions where young people can discuss and debate environmental policies and solutions. This encourages critical thinking, research skills, and civic engagement while fostering dialogue on pressing environmental issues and policy options.

By harnessing the creativity and ingenuity of humanity, we can unlock new pathways towards sustainability and resilience.



Looking Ahead

As we stand at the crossroads of history, the choices we make today will reverberate through the annals of time. In cultivating eco-literacy, we are not only preparing future generations to confront the challenges of climate change, but we are also sowing the seeds of a more harmonious relationship with the planet. It is a journey fraught with obstacles and uncertainties, yet it is also a journey filled with hope, possibility, and boundless potential.

Conclusion

In the grand of human existence, let us be the weavers of change, the architects of a more sustainable future. Through eco-literacy, we can illuminate pathways towards resilience, empowerment, and renewal. Let us seize this moment, this opportunity, to embark on a journey of discovery, understanding, and action. For in the end, it is not only our planet that stands to gain, but the very essence of what it means to be human

THANK YOU

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