

The mentors **Digest**



SEPTEMBER 2024

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The mentors monthly magazine

Time to change the way.....



Our Founder & his Vision

Knowledge is the prime wealth among all wealths. In other words, knowledge is the best and important wealth among all wealths. Start your journey to find or explore the knowledge. Our founder and renowned scholar late Padmashri Dr Vellayani Arjunan's vision is to spread quality education to entire community and make it affordable.



Shri. Vellayani Arjunan was born on 10 February 1933 at Vellayani in the erstwhile Kingdom of Travancore. After receiving a Master of Arts degree in Malayalam, he went on to teach Malayalam Language and Literature at

Degree	Topic	Awarding Institution
D.Litt.	Influence of Sree Narayana Guru on Malayalam Poetry.	Aligarh Muslim University
D.Litt.	A Comparative Study of the Mutual Relations and Uniformity of Hindi and Malayalam Languages.	Agra University
D.Litt.	The influence of Hindi Vocabularies on the South Indian Languages: A Linguistic study.	Jabalpur University
Ph.D.	A Comparative Linguistic Study of Common Vocables of Hindi and Malayalam Languages.	Aligarh Muslim University

Sree Narayana College in Kollam. He later became the first Malayalam lecturer in Aligarh Muslim University, from which he gained his PhD degree in 1964. After leaving Aligarh Muslim University, he was appointed director of the State Institute of Encyclopaedic Publications in Kerala

Other degrees

Degree	Subject
B.A. Hons	Malayalam Language and Literature
M.A.	Malayalam Language and Literature
M.A.	Hindi Language and Literature
M.A.	Hindi Special
P.G. Diploma	Tamil, Telugu, Kannada

He was honoured with the Padma Shri award by the nation in 2008. Dr Arjun, who was the first Professor of Malayalam at the Aligarh University and head of the Department of Modern Indian Languages. He supervised 20 research scholars and published more than 100 research papers and articles. He had authored 40 books in different genres including poetry, short story, essays and literary criticism, and his books were prescribed as textbooks in Kerala schools from 1959 onwards.





From the Editors Desk.....

Dear Students & future leaders,

Onam is an annual harvest and cultural festival celebrated mostly by the people of Kerala. A major annual event for Keralites, it is the official festival of the state and includes a spectrum of cultural events. Onam commemorates Vamana and the generous king Mahabali.



It is believed that on the occasion of Onam, King Mahabali visits his kingdom, and to welcome him, the people of Kerala create intricate floral patterns outside their homes. These patterns gradually evolved into the artful Pookalams we see today.

"May the festival of Onam bring you good health and immense joy." "On this festive occasion, may you be blessed with abundant joy and prosperity." "May the spirit of Onam stay in your heart and brighten your life." "Wishing you a joyous and prosperous Onam, filled with love and laughter."

WHAT IS SPECIAL ABOUT THE MONTH OF SEPTEMBER ?

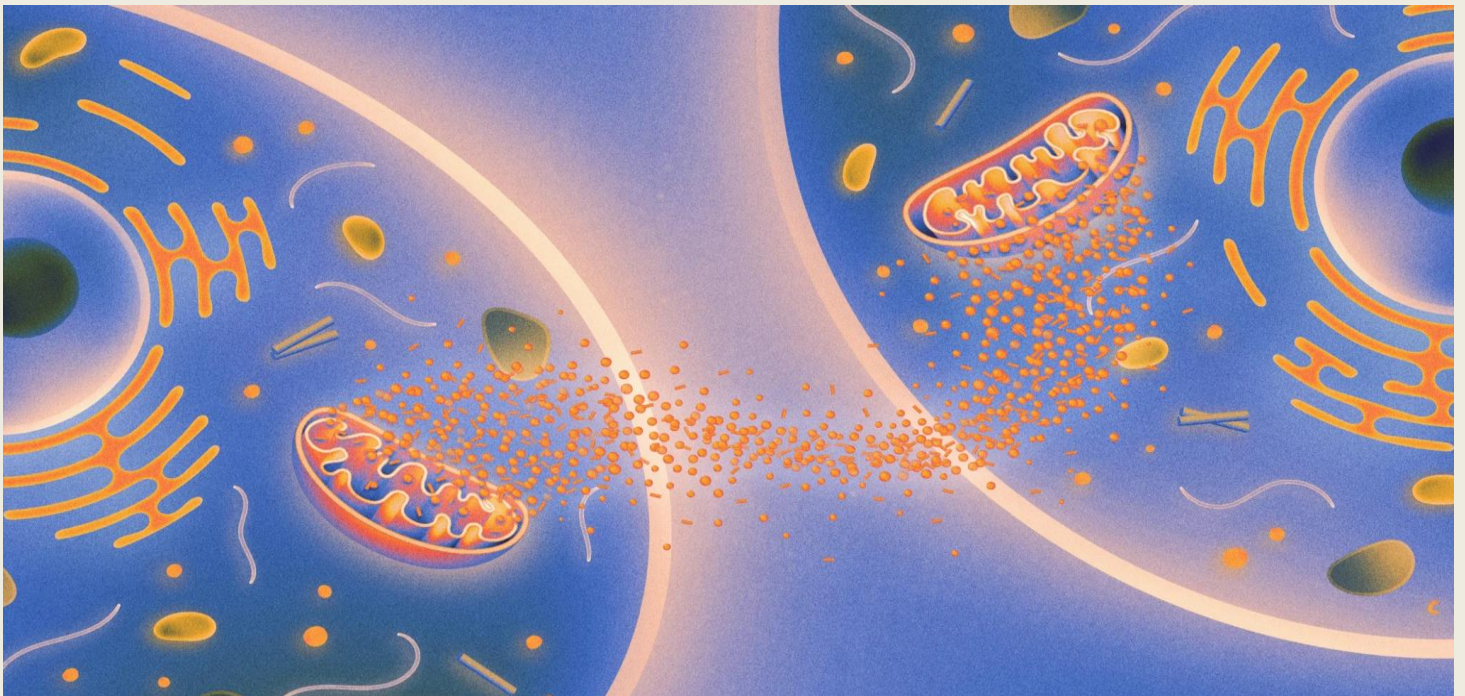
SEPTEMBER 16 : Ozone Day, officially known as the International Day for the Preservation of the Ozone Layer, is observed annually on September 16th. This day commemorates the signing of the Montreal Protocol on Substances that Deplete the Ozone Layer in 1987, a landmark international treaty designed to protect the ozone layer by phasing out the production and consumption of ozone-depleting substances (ODS). The ozone layer is a crucial component of Earth's atmosphere, located in the stratosphere. It absorbs the majority of the sun's harmful ultraviolet (UV) radiation, particularly UV-B radiation, which can cause skin cancer, cataracts, and other health problems, as well as negatively impact ecosystems. The theme for Ozone Day varies each year, focusing on different aspects of ozone layer protection and the ongoing efforts to mitigate climate change. Ozone Day serves as a reminder of the importance of international cooperation in addressing global environmental challenges. It also highlights the need to remain vigilant in protecting the ozone layer and continuing to work towards sustainable solutions that benefit both the environment and human health .





HOW CELLS COMMUNICATE ABOUT AGING

Scientists have discovered that cells in our bodies have a way of talking to each other that helps control aging. Inside our cells are tiny parts called mitochondria, known as the cell's powerhouse because they produce energy. Recently, researchers found that mitochondria don't just make energy—they also send signals to other cells to repair damage. This communication helps keep our bodies healthy and can even extend life. Aging might seem like it just happens naturally as we get older, but it turns out that our cells play an active role in the process. In 1993, scientists found that changing one gene in a small worm could double its lifespan. This showed that aging isn't entirely random—it's influenced by specific genes. In more recent research, scientists discovered a new way that aging is controlled. They found that when mitochondria in the brain get damaged, they send out signals that trigger repair processes in other cells throughout the body. This helps the organism stay healthier for longer. In fact, worms with repaired mitochondria lived 50% longer than those without these repairs! The cells responsible for producing eggs and sperm, known as germline cells, are particularly important in this communication process. These cells help relay the repair signals from the brain to the rest of the body, playing a key role in regulating aging. This research suggests that as long as these germline cells are healthy, they send signals that help keep the entire body in good shape. But as these cells age and their quality declines, the body receives fewer of these helpful signals, leading to the aging process. So, while we might not always think about it, the mitochondria in our cells are constantly communicating with each other to help manage how we age, keeping us healthier for as long as possible.





FUNGI FOUND IN CHERNOBYL FEEDS ON RADIATION, COULD PROTECT ASTRONAUTS

Scientists have discovered a type of fungi at the Chernobyl nuclear power plant that feeds on radiation, potentially offering a new way to protect astronauts in space. This fungi, *Cryptococcus neoformans*, was first found at Chernobyl in 1991, five years after the nuclear disaster. It contains high levels of melanin, the same pigment that gives color to our skin, which can absorb radiation and convert it into energy through a process called radiosynthesis.

This unique property has caught the attention of NASA scientists, who are exploring whether the fungi's melanin could be used as a natural shield against space radiation. Protecting astronauts from radiation is a major challenge, and traditional methods are often bulky and expensive. The idea is to create a lightweight, melanin-based coating that could safeguard both astronauts and equipment in space.

To test this theory, researchers from Johns Hopkins University sent melanin derived from the fungi to the International Space Station (ISS) in November 2019. The experiments aim to see how effective this melanin is at protecting against radiation in a real space environment. The results of these tests could lead to new, cost-effective ways of protecting astronauts.

If successful, this discovery could have significant implications not only for space travel but also for radiation protection on

Earth. Melanin-based products could be developed to protect against radiation in medical settings or during nuclear incidents.

As the research progresses, scientists are hopeful that this innovative approach could provide a powerful new tool for radiation protection, both in space and on Earth. The results of the experiments are expected soon, and they could mark a major breakthrough in how we approach the challenges of radiation exposure.



Did You Know ?

- A teaspoon of neutron star would weigh as much as Mount Everest. Neutron stars can also form strange structures called "nuclear pasta".



CAN VACCINES FOR WILDLIFE PREVENT HUMAN PANDEMICS?

Scientists are exploring the idea of using vaccines to stop viruses in wild animals before they can jump to humans and cause pandemics. Diseases that move from animals to humans, like COVID-19, are known as zoonoses. To prevent future pandemics, researchers are considering the use of "self-disseminating" vaccines that can spread through wild animal populations on their own, potentially stopping diseases at their source.

There are two main types of these vaccines: transferable and transmissible. Transferable vaccines are applied to one animal, like a bat, and spread to others through close contact, while transmissible vaccines use live modified viruses that can propagate within the animal population. Both methods aim to achieve widespread immunity among wildlife, which could prevent the spread of dangerous pathogens to humans.

Recent studies have shown promising results, such as the successful use of a transferable vaccine in vampire bats to combat rabies in Peru. Scientists are also working on transmissible vaccines that are safe and effective, though they acknowledge the need for caution to avoid any unintended consequences.

While the concept is still in development, researchers believe that investing in these preventative measures could be a game-changer in stopping pandemics before they start. By protecting wildlife, we could also protect ourselves, highlighting

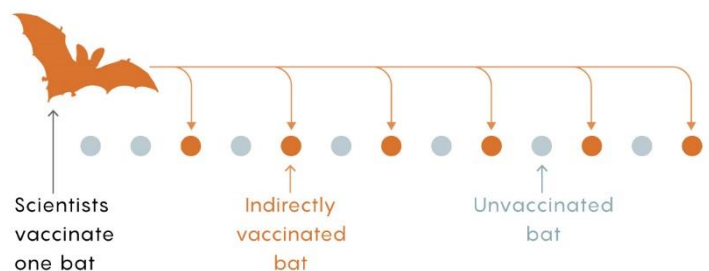
the interconnectedness of human and animal health.

How Vaccines Can Spread Themselves

Two types of self-disseminating vaccines could reduce the spread of infectious diseases in wildlife — a measure that might help prevent pandemics in humans.

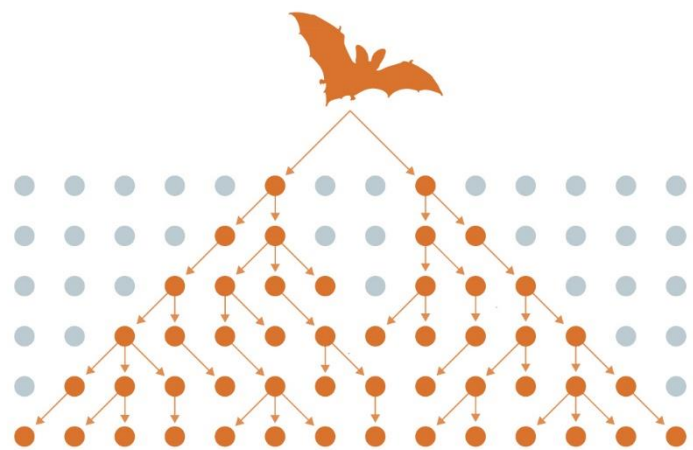
TRANSFERABLE VACCINE

A vaccinated bat or other animal passes on the vaccine to other individuals through physical contact. The spread is limited but can be enough to curb an infectious disease.



TRANSMISSIBLE VACCINE

Animals vaccinated with a live virus can infect other individuals, spreading immunity quickly.



Venus spins clockwise on its axis, unlike the other planets in our solar system which spin counterclockwise



MATHEMATICS TOPIC OF THE MONTH:

INVERSE TRIGONOMETRIC FUNCTIONS

CONCEPT MAP

Class XII

Function	Domain	Range	Graph
$y = \sin^{-1} x$	$[-1, 1]$	$[-\pi/2, \pi/2]$	
$y = \cos^{-1} x$	$[-1, 1]$	$[0, \pi]$	
$y = \tan^{-1} x$	R	$(-\pi/2, \pi/2)$	
$y = \cot^{-1} x$	R	$(0, \pi)$	
$y = \operatorname{cosec}^{-1} x$	$R - (-1, 1)$	$[-\pi/2, \pi/2] - \{0\}$	
$y = \sec^{-1} x$	$R - (-1, 1)$	$[0, \pi] - \{\pi/2\}$	

$$\sin(\sin^{-1} x) = x \text{ or } \sin^{-1}(\sin x) = x$$

$$\sin^{-1} 1/x = \operatorname{cosec}^{-1} x, x \geq 1 \text{ or } x \leq -1$$

$$\cos^{-1} 1/x = \sec^{-1} x, x \geq 1 \text{ or } x \leq -1$$

$$\tan^{-1} 1/x = \cot^{-1} x, x > 0$$

$$\sin^{-1}(-x) = -\sin^{-1} x, x \in [-1, 1]$$

$$\tan^{-1}(-x) = -\tan^{-1} x, x \in R$$

$$\operatorname{cosec}^{-1}(-x) = -\operatorname{cosec}^{-1} x, |x| \geq 1$$

$$\cos^{-1}(-x) = \pi - \cos^{-1} x, x \in [-1, 1]$$

$$\cot^{-1}(-x) = \pi - \cot^{-1} x, x \in R$$

$$\sec^{-1}(-x) = \pi - \sec^{-1} x, |x| \geq 1$$

1

Properties of Inverse Trigonometric Functions

2

$$\sin^{-1} x + \cos^{-1} x = \pi/2$$

$$\tan^{-1} x + \cot^{-1} x = \pi/2$$

$$\operatorname{cosec}^{-1} x + \sec^{-1} x = \pi/2$$

3

$$\begin{aligned} \tan^{-1} x - \tan^{-1} y &= \tan^{-1} \left(\frac{x-y}{1+xy} \right), xy > -1 \\ \tan^{-1} x + \tan^{-1} y &= \tan^{-1} \left(\frac{x+y}{1-xy} \right), xy < 1 \end{aligned}$$

4

$$2 \tan^{-1} x = \tan^{-1} \left(\frac{2x}{1-x^2} \right), -1 < x < 1$$

$$= \sin^{-1} \left(\frac{2x}{1+x^2} \right), |x| \leq 1 = \cos^{-1} \left(\frac{1-x^2}{1+x^2} \right), x \geq 0$$

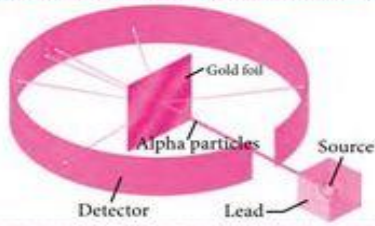


SCIENCE TOPIC OF THE MONTH:

ATOMS AND NUCLEI

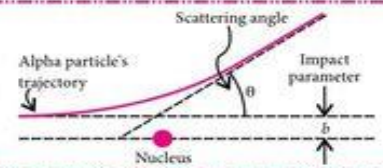
BRAIN
MAP

Class
XII



Rutherford's Model of Atom

- K.E. of α -particles, $K = \frac{1}{2}mv^2$
- Distance of closest approach,
$$r_0 = \frac{1}{4\pi\epsilon_0} \cdot \frac{2Ze^2}{K} = \frac{1}{4\pi\epsilon_0} \cdot \frac{4Ze^2}{mv^2}$$
- Impact parameter,
$$b = \frac{1}{4\pi\epsilon_0} \cdot \frac{Ze^2 \cot \frac{\theta}{2}}{K} = \frac{1}{4\pi\epsilon_0} \cdot \frac{Ze^2 \cot \frac{\theta}{2}}{\frac{1}{2}mv^2}$$
- **Conclusion** : An atom consists of a small and massive central core in which entire positive charge and whole mass of atom is concentrated.
- **Drawback** : The revolving electron continuously loses its energy due to centripetal acceleration and finally it should collapse into the nucleus.



Bohr's Atomic Model

Electron orbits and their energy

- Radius of permitted n^{th} orbits,
$$r_n = \frac{n^2 h^2}{4\pi^2 m k Z e^2} \Rightarrow r_n \propto n^2$$
- Velocity of electron in n^{th} orbit,
$$v_n = \frac{2\pi k Z e^2}{nh} \Rightarrow v_n \propto \frac{1}{n}$$
- Energy of electron in n^{th} orbit
$$E_n = \frac{-2\pi^2 m k^2 Z^2 e^4}{n^2 h^2} \Rightarrow E_n \propto \frac{1}{n^2}$$
 where the symbols have their usual meanings.

Line Spectra of Hydrogen

- While transition between different atomic levels, light radiated in various discrete frequencies are called spectral series of hydrogen atom.
- Rydberg formula :
$$\text{Wave number } \bar{\nu} = \frac{1}{\lambda} = R \left[\frac{1}{n_f^2} - \frac{1}{n_i^2} \right]$$
 $R = \text{Rydberg's constant} = 1.097 \times 10^7 \text{ m}^{-1}$

Radioactivity

- Law of radioactive decay
$$\frac{dN}{dt} = -\lambda N(t) \text{ or } N(t) = N_0 e^{-\lambda t}$$
- Half-life
$$T_{1/2} = \frac{\ln 2}{\lambda} = \frac{0.693}{\lambda}$$
- Mean life or Average life
$$\tau = \frac{1}{\lambda} = \frac{T_{1/2}}{0.693} = 1.44 T_{1/2}$$
- Fraction of nuclei left undecayed after n half lives is
$$\frac{N}{N_0} = \left(\frac{1}{2}\right)^n = \left(\frac{1}{2}\right)^{t/T_{1/2}}$$
 where $t = nT_{1/2}$

Decay Schemes

- α -Decay :
$${}_Z^A X \xrightarrow{\alpha\text{-decay}} {}_{Z-2}^{A-4} Y + {}_2^4 \text{He} + Q$$
 (Energy released)
- β -Decay :
$${}_Z^A X \xrightarrow{\beta^+} {}_{Z-1}^A Y + {}_{+1}^0 e + \bar{\nu}$$

$${}_Z^A X \xrightarrow{\beta^-} {}_{Z+1}^A Y + {}_{-1}^0 e + \bar{\nu}$$
- γ -Decay :
$${}_Z^A X^* \xrightarrow{\gamma\text{-decay}} {}_Z^A X + {}_0^0 \gamma$$
 (Excited state) (Ground state) + Energy

Composition and Size of Nucleus

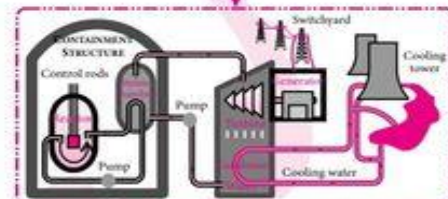
- Nucleus of an atom consists of protons and neutrons collectively called nucleons.
- Radius of a nucleus is proportional to its mass number as $R = R_0 A^{(1/3)}$, ($R_0 = 1.2 \text{ fm}$)

Concept of Binding Energy

- The binding energy is defined as the surplus energy which the nucleons give up by virtue of their attractions when they bound together to form a nucleus.
$$\Delta E_b = [Zm_p + (A - Z)m_n - M_N]c^2$$
- Binding energy per nucleon: $\therefore E_{bn} = \frac{E_b}{A}$

Nuclear Reactions

- **Nuclear fission** : It is the phenomenon of splitting a heavy nucleus into two or more smaller nuclei of nearly comparable masses.
- **Nuclear fusion** : It is the phenomenon of fusing two or more lighter nuclei to form a single heavy nucleus.



Application of Nuclear Reactions

- Fission**
 - Uncontrolled chain reaction: Principle of atomic bombs.
 - Controlled chain reaction: Principle of nuclear reactors.
- Fusion**

Nuclear fusion is the source of energy in the Sun and stars.

ATOMS
&
NUCLEI



TWIST YOUR MIND

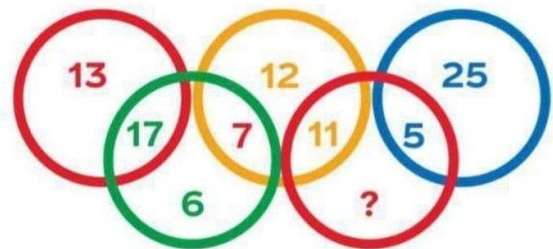
(Answers will be given in the October 2024 digest)

RIDDLES

1. What word contains 26 letters but only has three syllables ?
2. I am easy to lift, but hard to throw. What am I ?
3. Forward, I am heavy; backward, I am not. What am I?

PUZZLE

Can you find the missing number?



Bright Spots: Positive Events from AUGUST 2024

1. **Global Reforestation Efforts Expanded:** Significant new tree-planting initiatives launched in Brazil, Indonesia, and Africa.
2. **Breakthrough in Cancer Treatment:** New immunotherapy shows promising results in clinical trials.
3. **Historic Ocean Conservation Agreement:** Nations signed a landmark treaty to protect marine ecosystems and reduce plastic pollution.
4. **Launch of Major Clean Energy Projects:** New solar farm in the Sahara Desert and offshore wind farm in the North Sea inaugurated.
5. **Advances in Education Access:** New digital learning platforms launched to improve education in remote and underserved communities.
6. **Paris Olympics:** The United States dominated the Paris 2024 Olympics, securing the most medals overall.

word
of the
month

Accentuate: Make more noticeable or prominent

AUGUST ANSWERS

RIDDLES : 1. The alphabet m 2. Shirt
PUZZLE : 25

The mentors Digest



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JUNE 2023



JULY 2023



The mentors Digest



ABOUT US

Affordable Quality education

By understanding the need of aspiring students, India's renowned Industrial & Academic experts Mr. Manoj PL (Refining Specialist, Academician and founder Director Epinox Prompt Consulting Engineering Ltd), Ms. Chitra Jayasankar (Educational advisor, Tagore Educational trust) are there to bridge the gap of ensuring quality education for the students. We have formulated an online platform for providing significantly exceeding educational experience through online tuitions (classes 6-12), IAS bridge programs and finishing school for fresh engineers and other professionals. We will ensure excellent learning experience to students and 100% satisfaction level to parents.

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