UPSC CURRENT AFFAIRS NOTES 06-02-2024

GRAPES 3 EXPERIMENT

The GRAPES-3 experiment has discovered a new feature in the cosmic-ray proton spectrum at about 166 tera-electron-volt (TeV) energy.

The observed feature suggests a potential re-evaluation of our understanding of cosmic-ray sources, acceleration mechanisms, and their propagation within our galaxy.

Details

- Cosmic rays, discovered over a century ago, are the **most energetic particles observed in the universe**.
- They continuously bombard Earth's atmosphere from outer space, displaying a uniform distribution from all directions.
- Upon entering the atmosphere, **cosmic rays initiate a cascade of particles, including electrons, photons, muons, protons, and neutrons, which travel to Earth's surface at speeds close to that of light.**
- The observation of cosmic rays spans a wide energy spectrum, ranging from 10^8 to 10^20 electron volts (eV), with the flux decreasing steeply with increasing energy, following a power law distribution.
- The **"Knee," a notable deviation in the cosmic-ray proton spectrum around 3 peta-electron-volts (PeV), has been recognized for nearly seven**

decades, indicating the presumed upper limit of energy for cosmic-ray acceleration within Galactic sources.

- However, the recent revelation by the GRAPES-3 experiment unveils a **new feature in the cosmic-ray spectrum exceeding 100 TeV but remaining below the Knee.**
- This observation challenges the previously accepted hypothesis proposing a single power law representation of the spectrum up to the Knee energy threshold, prompting a re-evaluation of existing theoretical models.

About GRAPES-3

- The GRAPES-3 experiment, also known as the Gamma Ray Astronomy PeV EnergieS phase-3, is a collaborative effort between the Indian Tata Institute of Fundamental Research, the Japanese Osaka City University, and the Japanese Nagoya Women's University.
- **Located in Ooty, GRAPES-3** aims to study cosmic rays using an array of air shower detectors and a large-area muon detector.

Objectives:

- **Acceleration of Cosmic Rays:** Investigate the origin, acceleration, and propagation of cosmic rays with energies exceeding 10^14 eV in the galaxy and beyond.
- **Knee in Energy Spectrum:** Determine the existence and characteristics of the "knee" in the energy spectrum of cosmic rays.
- **High-Energy Cosmic Rays:** Study the production and acceleration mechanisms of the highest energy cosmic rays, reaching energies around 10^20 eV, in the universe.
- **Gamma-Ray Astronomy:** Explore the astronomy of multi-TeV gamma rays emitted from neutron stars and other compact objects.
- **Solar Effects:** Investigate the Sun as the closest astrophysical object, its role as an accelerator of energetic particles, and its effects on Earth.

Overview:

- The history of cosmic ray research in Ooty dates back to 1955 when B. V. Sreekantan initiated the first experiments using cloud chambers at the Cosmic Ray Laboratory (CRL).

- Over the years, various experiments were conducted at the CRL, including studies on high-energy interactions, extensive air showers, and high-energy nuclear interactions.
- The GRAPES-1 experiment was subsequently upgraded to GRAPES-2 before the establishment of GRAPES-3 at a new site called the RAC site, 8 km away from the old site, due to technical and administrative constraints.
- GRAPES-3 currently operates with approximately 400 plastic scintillator detectors, each covering an area of 1 m^2, with a separation of 8 meters between detectors.
- The experiment aims to record the density and arrival time of particles in cosmic ray showers continuously.
- GRAPES-3 boasts the highest density conventional Extensive Air Shower (EAS) array globally and includes a massive 560 m^2 area tracking muon detector, making it the largest area tracking detector in the world.

MUTATION IN CABBAGE

The discovery of a natural mutation in cabbage plants that renders them male-sterile presents a unique opportunity to explore the genetic mechanisms governing fertility in plants.

This mutation, named Ms-cd1, has significant implications for agriculture due to its potential to enhance crop yield through heterosis

Details

Genetic Basis of Male Sterility

Identification of Ms-cd1 Mutation:

The Ms-cd1 mutation was discovered approximately 44 years ago, initially observed in cabbage plants unable to produce pollen.

Despite male sterility, these plants were capable of producing seeds through out-crossing, resulting in hybrid vigor.

Dominant Nature of the Mutation:

Studies revealed that the Ms-cd1 mutation behaves as a dominant trait, leading to male sterility when present in only one chromosome of the pair.

This dominance simplifies the process of scaling up hybrid seed production, as only one mutated allele is required for male sterility.

Molecular Mechanism of Male Sterility

Role of Promoter Region:

Genetic mapping studies identified a crucial deletion in the promoter region of the Ms-cd1 gene associated with male sterility.

This deletion disrupts the binding of a regulatory protein, leading to aberrant expression of the gene and subsequent male sterility.

Fine-Tuning of Gene Expression:

The Ms-cd1 gene, spanning approximately 6 kilo base-pairs (kbp), encodes a protein essential for pollen development.

Proper regulation of Ms-cd1 expression is critical for maintaining the delicate balance required for pollen development.

Impact on Pollen Development:

Mutations affecting Ms-cd1 protein levels, either through the deletion or additional mutations, result in disruptions to pollen development.

The precise timing and quantity of Ms-cd1 expression are essential for normal pollen development, highlighting the intricate regulatory mechanisms involved.

Potential Applications and Implications

Enhanced Crop Yield:

The Ms-cd1 mutation offers a promising tool for enhancing crop yield through the production of hybrid seeds with improved vigor.

Introduction of the dominant mutation into other plant species, such as rice, tomato, and Arabidopsis, demonstrates its potential applicability across diverse crops.

Future Research Directions:

Further investigation into the molecular pathways governing pollen development and gene regulation will deepen our understanding of plant fertility.

Continued exploration of similar mutations and their effects on crop yield may uncover additional strategies for agricultural improvement.

About Mutation

A mutation is a permanent alteration in the DNA sequence of an organism.

It can occur in various forms, including substitutions, insertions, deletions, and rearrangements, leading to changes in the genetic code.

Types of Mutations:

Point Mutations:

Substitution: One nucleotide is replaced by another. This can be silent (no change in amino acid), missense (change in amino acid), or nonsense (premature stop codon).

Insertion: One or more nucleotides are added to the DNA sequence.

Deletion: One or more nucleotides are removed from the DNA sequence.

Frameshift Mutations:

Insertions or deletions that alter the reading frame of the genetic code, leading to a cascade of incorrect amino acids being translated.

Chromosomal Mutations:

Larger scale mutations involving changes in chromosome structure or number, including duplications, inversions, translocations, and aneuploidy.

Causes of Mutations:

Spontaneous Mutations:

Errors during DNA replication.

Chemical changes such as deamination, oxidation, or depurination.

Induced Mutations:

Exposure to mutagenic agents such as radiation (UV, X-rays, gamma rays) or certain chemicals (e.g., polycyclic aromatic hydrocarbons).

Effects of Mutations:

Neutral Mutations:

Mutations that do not confer a selective advantage or disadvantage. They may accumulate in the genome without significant impact on the organism.

Beneficial Mutations:

Mutations that provide a selective advantage, enhancing the organism's fitness in its environment.

Harmful Mutations:

Mutations that result in reduced fitness or disease. Examples include genetic disorders like cystic fibrosis, sickle cell anemia, and cancer-causing mutations.

Significance of Mutations:

Evolutionary Mechanism:

Mutations provide the raw material for evolution by introducing genetic diversity within populations, which natural selection acts upon.

Genetic Variation:

Mutations contribute to genetic variation among individuals, populations, and species.

Biomedical Research:

Studying mutations helps in understanding the molecular basis of diseases, developing diagnostics, and designing therapeutic interventions.

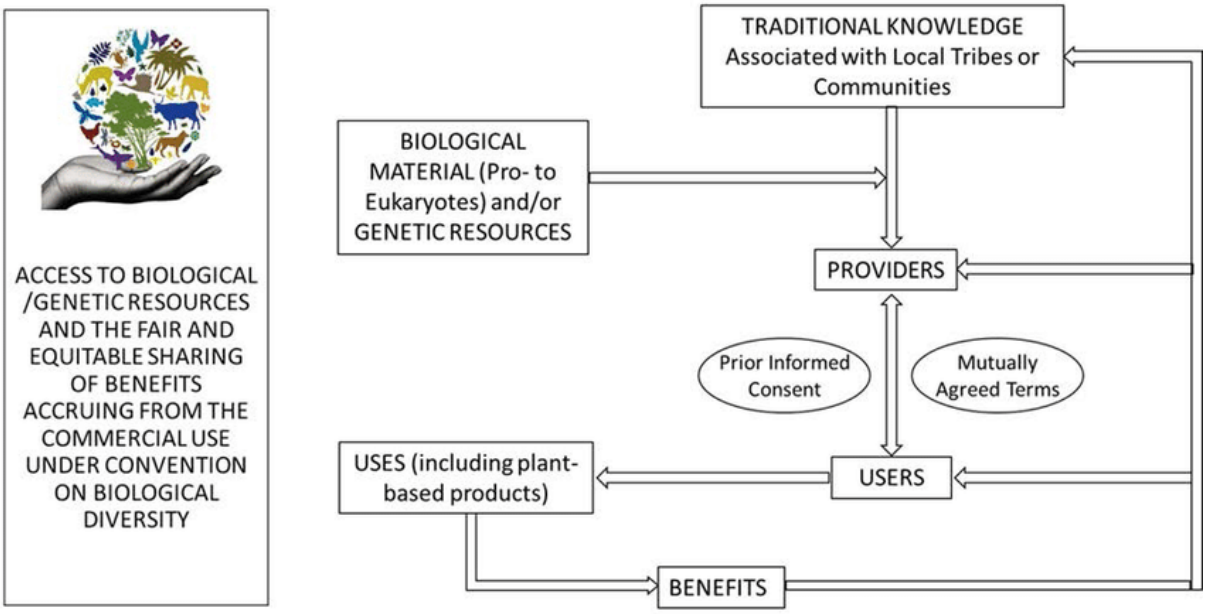
Biotechnology:

Mutations are harnessed in biotechnology for purposes such as creating genetically modified organisms (GMOs), producing desired traits in crops, or engineering microbes for industrial applications.

Nagoya Protocol

Cameroon recently adopted the Nagoya Protocol on Access and Benefit Sharing.

Nagoya Protocol on Access and Benefit Sharing



About Nagoya Protocol:

- The Nagoya Protocol on Access to Genetic Resources and the Fair and Equitable Sharing of Benefits Arising from their Utilization (the Protocol) is a legally binding global agreement that implements the access and benefit-sharing obligations of the Convention on Biological Diversity (CBD).
- It was adopted by the CBD in Nagoya, Japan, in October 2010 and entered into force on October 12, 2014, 90 days after the deposit of the fiftieth instrument of ratification.
- It provides a transparent legal framework for the effective implementation of one of the three objectives of the CBD: the fair and equitable sharing of benefits arising out of the utilization of genetic resources.

What are the benefits?

- It establishes a framework that helps researchers access genetic resources for biotechnology research, development, and other activities, in return for a fair share of any benefits from their use.
- This provides the research and development sector with the certainty they need to invest in biodiversity-based research.

- Indigenous and local communities may receive benefits through a legal framework that respects the value of traditional knowledge associated with genetic resources.

What does the Nagoya Protocol cover?

- It applies to genetic resources that are covered by the CBD, and to the benefits arising from their utilization.
- It also covers traditional knowledge (TK) associated with genetic resources that are covered by the CBD and the benefits arising from their utilization.

Key Facts about Convention on Biological Diversity (CBD):

- CBD, with 196 contracting parties, is the most comprehensive binding international agreement in the field of nature conservation and the sustainable use of natural resources.
- It was opened for signing at the UN Conference on Environment and Development in Rio de Janeiro in 1992.

It has three overarching objectives:

- The conservation of biological diversity (genetic diversity, species diversity, and habitat diversity).
- The sustainable use of biological diversity.
- The fair and equitable sharing of the benefits arising out of the utilisation of genetic resources.

ABHYAS

The Defence Research and Development Organisation (DRDO) successfully conducted four flight trials of the high-speed expendable aerial target 'ABHYAS' recently.

About ABHYAS:

- It is a high-speed expendable aerial target (HEAT).
- It is designed by the DRDO's Aeronautical Development Establishment (ADE).
- ABHYAS offers a realistic threat scenario for the practice of weapon systems.
- It is the ideal platform for the validation of Armed Forces equipment slated for induction (only those that require aerial engagement).

Features:

- It is designed for autonomous flying with the help of an autopilot indigenously made by the ADE.
- It has a radar cross-section and a visual and infrared augmentation system required for weapon practice.
- The target drone has a laptop-based Ground Control System with which the aircraft can be integrated and pre-flight checks, data recording during the flight, replays after the flight and post-flight analysis can be carried out.

Key Facts about DRDO:

- It is the R&D wing of the Ministry of Defence, Govt. of India, with a vision to empower India with cutting-edge defence technologies and a mission to achieve self-reliance in critical defence technologies and systems.
- It is India's largest research organisation.
- **Formation**: The organisation was formed in 1958 from the amalgamation of the then- existing Technical Development Establishment (TDEs) of the Indian Army and the Directorate of Technical Development and Production (DTDP) with the Defence Science Organisation (DSO).
- **Headquarters: New Delhi.**
- It has a network of laboratories engaged in developing defence technologies covering various fields, like aeronautics, armaments, electronics, land combat engineering, life sciences, materials, missiles, and naval systems.

Radar

Radar stands for "Radio Detection and Ranging." It is a technology used to detect and track objects, such as aircraft, ships, weather formations, and other physical phenomena. Radar works by emitting electromagnetic waves (radio waves) and then analyzing the reflections or echoes of those waves when they bounce back after hitting an object.

International Centre for Integrated Mountain Development

Experts from the International Centre for Integrated Mountain Development (ICIMOD) declared the Hindu Kush Himalaya region a biosphere on the brink of collapse and called for bold action and urgent finance to prevent nature loss.

About International Centre for Integrated Mountain Development:

- It is an intergovernmental knowledge and learning centre working on behalf of the people of the Hindu Kush Himalaya (HKH).
- It was formally established and inaugurated on 5 December 1983.
- Mission: To build and share knowledge that drives regional policy and action and attracts investment that enables the diverse countries and communities of the HKH to transition to greener, more inclusive, and climate resilient development.
- Member countries]
- – Afghanistan, Bangladesh, Bhutan, China, India, Myanmar, Nepal, and Pakistan.

Governance

- Its **Board of Governors** is the highest governing body of the centre.
- It consists of one representative from each of eight regional member countries and independent members who are nominated by the ICIMOD Support Group based on their recognized professional expertise and experience.

Functions

- It serves the region through information and knowledge generation and sharing to find innovative solutions to critical mountain problems.
- It **bridges science with policies** and on-the-ground practices.

- It provides a regional platform where experts, planners, policymakers, and practitioners can exchange ideas and perspectives towards the achievement of sustainable mountain development.
- **Headquarter:** Kathmandu, Nepal

Key facts about Hindu Kush Himalaya

- The HKH region extends 3,500 km over all or part of eight countries from Afghanistan in the west to Myanmar in the east.
- It is the source of ten large Asian river systems – the Amu Darya, Indus, Ganges, Brahmaputra (Yarlungtsanpo), Irrawaddy, Salween (Nu), Mekong (Lancang), Yangtse (Jinsha), Yellow River (Huanghe), and Tarim (Dayan).
- It provides water, ecosystem services, and the basis for livelihoods to people in the region.

GRI BIODIVERSITY STANDARD

Context: The Global Reporting Initiative (GRI) has introduced an updated transparency standard, known as the GRI Biodiversity Standard, to address the global biodiversity crisis.

Details

- The Global Reporting Initiative (GRI) new standards aim to assist businesses, governments, and other entities in understanding and reporting their impacts on biodiversity, alongside issues related to climate change, human rights, and corruption.
- **Developed by the Global Sustainability Standards Board (GSSB),** the GRI Biodiversity Standard demands accountability from organizations

regarding their impacts on biodiversity through supply chains and operations.

- The GRI Biodiversity Standard **aims to provide a comprehensive framework for reporting biodiversity impacts**, thereby enabling organizations to understand and address their environmental responsibilities.

Key points about the GRI Biodiversity Standard

- **Effective Date and Implementation:** The new standard, named GRI 101: Biodiversity 2024, will be formally implemented for reporting purposes from January 1, 2026. This gives organizations time to familiarize themselves with the standard and make necessary adjustments to comply with its requirements.
- **Piloting and Community Engagement:** In the two years leading up to the implementation, GRI plans to pilot the use of the standard with early adopters and prioritize engagement with community members. This approach ensures that the standard is practical and meets the needs of diverse stakeholders.
- **Alignment with Global Developments:** The GRI Biodiversity Standard is aligned with crucial global developments in the biodiversity field, including the United Nations Kunming-Montreal Global Biodiversity Framework, the Science-Based Target Network, and the Taskforce on Nature-Related Financial Disclosures. This alignment ensures that reporting under the standard is consistent with international biodiversity goals and frameworks.
- **Transparency and Accountability:** The standard promotes transparency throughout the supply chain, addressing the underreporting of major biodiversity impacts. It requires organizations to disclose location-specific impacts, including countries and operational sites, as well as direct drivers of biodiversity loss such as land use, pollution, invasive species, and climate change.
- **Impacts on Communities and Indigenous Peoples:** The standard also emphasizes the impacts of organizations on communities and Indigenous Peoples, as well as the importance of engaging with local groups to restore affected ecosystems. This reflects a holistic approach to biodiversity conservation that considers social and cultural dimensions.

Global Reporting Initiative (GRI)

What is GRI?

- The Global Reporting Initiative (GRI) is an independent, international organization that provides the world's most widely used standards for sustainability reporting.
- Founded in 1997, GRI's mission is to empower organizations to understand and communicate their impacts on the environment, economy, and society.

What does GRI do?

- **Sustainability Reporting Standards:** These comprehensive guidelines outline the topics and indicators organizations should report on, ensuring transparency and comparability across industries.
- **Technical Guidance:** GRI provides additional resources to help organizations interpret and apply the standards, including sector-specific guidance and best practice examples.
- **Training and Capacity Building:** GRI offers various training programs and workshops to equip organizations with the knowledge and skills needed for effective sustainability reporting.
- **Stakeholder Engagement:** GRI encourages organizations to engage with stakeholders throughout the reporting process to ensure their reports are relevant and address their concerns.

Why is GRI important?

Sustainability reporting is becoming increasingly important for organizations as stakeholders demand greater transparency and accountability. GRI standards provide a framework for organizations to communicate their sustainability performance in a credible and comparable way, which can lead to several benefits:

- **Enhanced Transparency:** GRI reporting helps organizations identify and address their sustainability impacts, leading to improved transparency and accountability.
- **Stakeholder Engagement:** By reporting on their sustainability performance, organizations can engage more effectively with stakeholders, build trust, and manage risks.
- **Improved Performance:** GRI reporting can help organizations identify areas for improvement and set ambitious sustainability goals, ultimately leading to better performance.
- **Access to Capital:** Investors are increasingly integrating sustainability factors into their investment decisions. GRI reporting can help organizations attract sustainable investments.

Conclusion

- The GRI Biodiversity Standard sets a benchmark for organizations to report their impacts on biodiversity and demonstrates their commitment to environmental stewardship. By providing a structured framework for transparency and accountability, the standard contributes to global efforts to halt and reverse biodiversity loss and build a nature-positive future.

Coronal Mass Ejections (CMEs)

An Indian Institute of Astrophysics (IIA) team along with their international collaborators recently developed a new model of the internal thermal evolution of coronal mass ejections (CMEs), as they travel from the sun toward the earth.

About Coronal Mass Ejections (CMEs):

- CMEs are **large expulsions of plasma and magnetic field from the sun's** atmosphere—the **corona**, **that propagate outward** into interplanetary space.
- During a CME, the sun **releases a colossal amount of material, including electrons, protons,** and heavier ions, **as well as magnetic fields.**

How are they formed?

- They form **similarly to solar flares**—a **result of the twisting and realignment of the sun's magnetic field**, known as **magnetic reconnection.**
- When magnetic field lines "tangle" they **produce strong localized magnetic fields which can break through the surface** of the sun at active regions, **subsequently generating CMEs.**
- CMEs **usually take place around sunspot groups** and are **often accompanied by a solar flare**, though the two **don't always occur in tandem**.
- CMEs **travel outward from the sun** at speeds ranging from slower than 250 kilometers per second (km/s) to as fast as 3000 km/s.
- The fastest Earth-directed CMEs **can reach our planet in as little as 15-18 hours**.
- **They expand in size as they propagate away** from the Sun, and larger CMEs can reach a size comprising nearly a quarter of the space between Earth and the Sun by the time they reach our planet.
- CMEs, like solar flares, are **most common during the solar maximum**, a period in the sun's 11-year cycle of activity when the star is at its most active.

Impact on Earth:

- **Geomagnetic Storms:** The interaction between the CME's magnetic fields and Earth's magnetosphere can lead to geomagnetic storms. These

can disrupt satellite communications, navigation systems, and even power grids.

- **Auroras**: CMEs can cause spectacular displays of the Northern and Southern Lights, also known as auroras, by energizing particles in Earth's atmosphere.
- **Radiation Hazards:** Astronauts in space or passengers on high-altitude flights can be exposed to elevated levels of radiation during a CME event.

Key Facts about Solar Flare:

- It is an **intense burst of radiation** coming **from the release of magnetic energy associated with sunspots.**
- Flares are our **solar system's largest explosive events**.
- They are **seen as bright areas on the sun**, and they can **last from minutes to hours.**
- In a matter of just a few minutes, they **heat the material to many millions of degrees** and **produce a burst of radiation** across the electromagnetic spectrum, including **from radio waves to x-rays and gamma rays.**
- Although solar flares can be visible in white light, they are often more readily noticed via their bright X-ray and ultraviolet emissions.

Effect of Solar Flare on Earth:

- The intense radiation emitted during a solar flare can **affect satellite communications, disrupt radio signals**, and even pose a **risk to astronauts** in space.
- Additionally, the increased solar radiation can lead **to geomagnetic storms,** which may **impact power grids** and **cause auroras** (northern and southern lights) at lower latitudes.

What are Sunspots

Sunspots are dark, planet-size regions of strong magnetic fields on the surface of the sun. **They can spawn eruptive disturbances such as solar flares and coronal mass ejections (CMEs)**. These regions of the sun appear darker because they are cooler than their surroundings.