GENOME INDIA PROJECT: SCIENCE & TECHNOLOGY

NEWS: 10,000 human genomes database launched

WHAT'S IN THE NEWS?

The Genome India Project is an initiative to create a genetic database of 10,000 genomes from 83 diverse Indian population groups, aiming to advance research in disease genetics, drug therapy, precision medicine, and biotechnology while ensuring data privacy and global accessibility.

Objective and Vision

- The Genome India Project aims to map India's genetic diversity comprehensively.
- Its primary goals are to:
    1. Enhance disease research by identifying genetic predispositions.
    2. Facilitate drug therapy development tailored to Indian populations.
    3. Support the growth of precision medicine for personalized healthcare interventions.

Scope and Scale

- **Diverse Representation**: Includes 10,000 genomes, representing 83 population groups (about 2% of India's total 4,600 groups).
- **Limited Yet Significant**: Although covering a small portion of India's genetic diversity, it lays the groundwork for future expansion to a million genomes.

Database and Accessibility

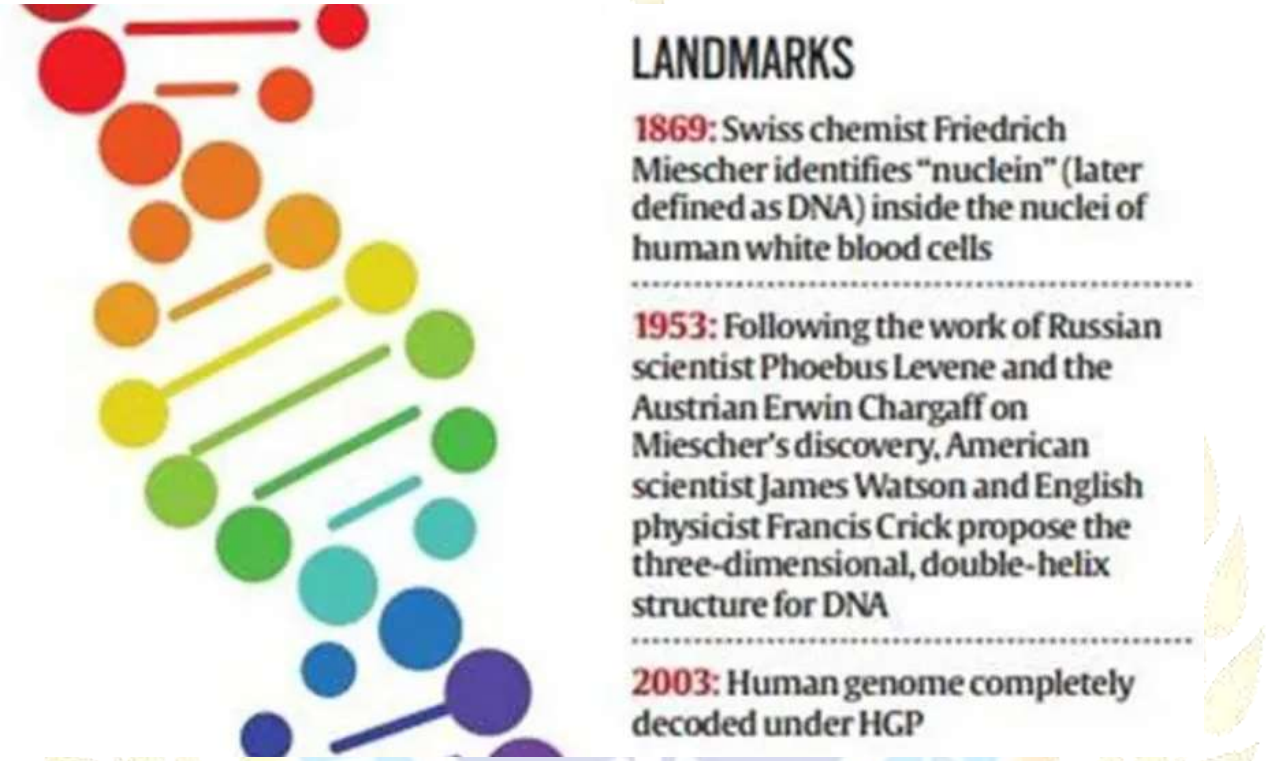
- **Location**: The genetic database is housed at the Indian Biological Data Centre (IBDC) in Faridabad, Haryana.
- **Global Accessibility**: Researchers worldwide can access the anonymized database after their proposals are reviewed and approved by an independent panel.

Key Genomic Insights

- **Unique Variants**: The project has identified approximately 27 million low-frequency genetic variants, including 7 million unique to Indian populations, absent in global databases.
- **Disease Understanding**: These insights help identify genetic markers linked to diseases prevalent among Indian populations, improving targeted interventions.

Advancing Precision Medicine

- **Personalized Healthcare**: Provides the foundation for therapies and treatments tailored to specific genetic profiles.
- **Impact on Biotech and Pharma**: Supports the development of region-specific medicines and technologies.



Privacy and Ethical Framework

- **Anonymized Data**: All genetic data is converted into numeric codes to ensure participant privacy.
- **Access Control**: A strict review process by an independent panel prevents misuse and ensures ethical research.

Future Potential and Impact

- **Scaling Up**: Plans to expand the project to a million genomes will enable better representation of India's diverse genetic landscape.
- **Global Leadership**: Strengthens India's position as a leader in genomics and biotechnology research.
- **Economic and Health Benefits**: Encourages innovation in healthcare and pharmaceutical sectors while addressing public health challenges.

What is Genome Sequencing?

DNA and Genes:

1. **DNA (Deoxyribonucleic Acid):**
    - A molecule that contains the genetic instructions for the development, functioning, growth, and reproduction of all living organisms and many viruses.
    - Composed of four chemical bases: **Adenine (A), Thymine (T), Cytosine (C), and Guanine (G)**.
2. **Genes:**
    - Segments of DNA that act as instructions to produce proteins.
    - Proteins are essential for biological processes such as growth, repair, and regulation of body functions.
3. **Genome:**
    - The entire set of DNA, including all genes, within an organism.
    - The human genome consists of about **3 billion base pairs** arranged in a specific sequence that determines biological traits, susceptibility to diseases, and more.

Genome Sequencing:

- A scientific process to determine the exact order of the four nucleotide bases (A, T, C, and G) in an organism's entire genome.
- Provides a complete map of an individual's genetic blueprint.

Procedure of Genome Sequencing:

1. **Extracting DNA:**
    - DNA is collected from biological samples such as blood, saliva, or tissue.
2. **Fragmenting DNA:**
    - The DNA is broken into smaller, more manageable pieces.
    - Each fragment is tagged with **fluorescent markers** for identification during sequencing.
3. **Sequencing DNA:**

- Specialized machines called **DNA sequencers** read the order of nucleotide bases in the tagged fragments.

4. **Analyzing Data:**
    - Advanced computational tools and algorithms combine the sequence data from all fragments.
    - This creates the complete genetic sequence, revealing insights into an individual's genetic makeup.

GENERAL FACTS

1. **First Human Genome Sequenced:**
    - The Human Genome Project (1990–2003) sequenced the first complete human genome.
    - It took **13 years** and cost approximately **$3 billion**.
2. **India's Milestone:**
    - In **2009**, India achieved its first complete genome sequencing.
3. **Technological Advancements:**
    - Today, sequencing an entire human genome takes **just 5 days** due to advancements in technology, making it faster, cheaper, and more accessible.

Source: https://www.thehindu.com/sci-tech/science/10000-human-genomes-database-launched/article69081500.ece#:~:text=India%20has%20completed%20and%20made,into%20disease%20and%20drug%20therapy.