

BIO-TECHNOLOGY

❖ **Genome sequencing**

➤ **CONTEXT:** The Department of Biotechnology (DBT) recently said that the exercise to sequence 10,000 Indian human genomes and create a database under the Centre-backed Genome India Project is about two-thirds complete. About 7,000 Indian genomes have already been sequenced of which, 3,000 are available for public access by researchers.

- The proponents of the project say it would enable researchers anywhere in the world to learn about genetic variants unique to the Indian population.
- Countries including the United Kingdom, China, and the United States have launched similar programmes to sequence at least 1,00,000 of their population's genomes.

➤ **What is genome sequencing?**

- The human genome is the entire set of deoxyribonucleic acid (DNA) residing in the nucleus of every cell of each human body.
- It carries the complete genetic information responsible for the development and functioning of the organism.
- The DNA consists of a double-stranded molecule built up by four bases namely:
 - ✓ Adenine (A)
 - ✓ Cytosine (C)
 - ✓ Guanine (G)
 - ✓ Thymine (T).
- Every base on one strand pairs with a complementary base on the other strand (A with T and C with G) In all, the genome is made up of approximately 3.05 billion such base pairs. .
- While the sequence or order of base pairs is identical in all humans, compared to that of a mouse or another species, there are differences in the genome of every human being that makes them unique.
- The process of deciphering the order of base pairs, to decode the genetic fingerprint of a human is called genome sequencing.
- In 1990, a group of scientists began to work on determining the whole sequence of the human genome under the Human Genome Project. The first results of the complete human genome sequence were given in 2003. However, some percentage of repetitive parts were yet to be sequenced.
- The Human Genome Project released the latest version of the complete human genome in 2023, with a 0.3% error margin.
- Costs of sequencing differ based on the methods employed or the accuracy expected. Since an initial rough draft of the human genome was made available, companies have aimed to reduce the cost of generating a fairly accurate "draft" of any individual genome— it has now fallen to a tenth, or to around \$1,000 or less (approximately ₹70,000).
- Genomic sequencing has now evolved to a stage where large sequencers can process thousands of samples simultaneously. There are several approaches to genome sequencing (including whole genome sequencing or next generation sequencing) that have different advantages.
- The process of whole-genome sequencing, made possible by the Human Genome Project, now facilitates the reading of a person's individual genome to identify differences from the average human genome.
- These differences or mutations can tell us about each human's susceptibility or future vulnerability to a disease, their reaction or sensitivity to a particular stimulus, and so on.

➤ **What are the applications of genome sequencing?**

- Genome sequencing has been used to evaluate rare disorders, preconditions for disorders, even cancer from the viewpoint of genetics, rather than as diseases of certain organs. Nearly 10,000 diseases (including cystic fibrosis and thalassemia) are known to be the result of a single gene malfunctioning.
- In the past decade, it has also been used as a tool for prenatal screening, to investigate whether the foetus has genetic disorders or anomalies. The Nobel Prize-winning technology Crispr, which relies on sequencing, may potentially allow scientists to repair disease-causing mutations in human genomes. Liquid biopsies, where a small amount of blood is examined for DNA markers, could help diagnose cancer long before symptoms appear.
- In public health, however, sequencing has been used to read the codes of viruses—one of its first practical usages was in 2014, when a group of scientists from M.I.T and Harvard sequenced samples of Ebola from infected African patients to show how genomic data of viruses could reveal hidden pathways of transmission, which might then be halted, thus slowing or even preventing the infection's spread.
 - ✓ Experts say that as sequencing gets cheaper, every human's genome may feasibly be sequenced as part of routine health care in the future, to better understand personal molecular biology and health.
- At the population level as well, genomics has several benefits. Advanced analytics and AI could be applied to essential datasets created by collecting genomic profiles across the population, allowing to develop greater understanding of causative factors and potential treatments of diseases. This would be

- **CONTEXT: The U.S. announced new commitments in support of the country's transition to cleaner energy aims to have 50% of all new vehicle sales be electric by 2030.**
- Earlier in April 2023, the Biden administration proposed new, tougher vehicle pollution standards in a bid to promote the use of EVs in the U.S.
- **What are the commitments made by the USA?**
- The new private and public sector commitments announced under President Biden's Investing in America initiative. They are aimed at accelerating the growth of the EV industry by increasing consumer demand, lowering costs, and promoting inclusion.
- The four-pronged approach includes EV fleet expansion; community charging (commercial and multifamily); consumer education and support; and providing tools and resources.
- **EV fleet expansion:** This includes coordination with popular ride-sharing companies as well as EV component producers. For example, Uber has committed to reaching 400 million EV miles driven on its platform in the U.S. by the end of 2023. Xcel Energy and Colorado Car Share have committed to launch an electric car-sharing programme for underserved and high-emissions communities in Colorado by the end of 2023. On the other hand, Redwood Materials is committed to scaling the production of critical battery components in the U.S., with the goal of powering five million EVs by 2030.
- **Community charging (commercial and multifamily):** This covers commitments by companies to add EV charging stations to make the facility more accessible to the public. For example, Span.IO, Inc. has committed to triple the number of EV home charger installs by 2024; and Blink Charging has committed to invest \$49 million to increase its manufacturing capacity in Bowie, Maryland from 10,000 to 40,000 chargers per year by 2024.
- **Consumer education and support:** This includes collaboration with non-profit organisations, events, etc. to educate consumers about the benefits of EVs over conventional fuel-powered automobiles. For example, Avanza EV has committed to deploy chargers and bilingual EV education in at least 1,500 low-income majority Latino multifamily housing communities and engage at least 400,000 families by 2028. Climate Power has committed to educate over a million people about EVs through its influencer network by June 2024.
- **Tools and resources:** Both private and public sector companies aim to use online training, savings prediction calculators, web portals, and other tools and resources to encourage Americans to switch to EVs. Exelon has committed to offering a comprehensive fleet electrification assessment service to help customers and businesses navigate vehicle electrification, create fleet electrification plans, and estimate total costs of ownership savings. National Automobile Dealers Association and Centre for Sustainable Energy have committed to launch online dealer training in 2023 to help them accelerate EV sales as well as mass-market EV adoption.
- **The new proposed vehicle pollution standards**
- The U.S. Environmental Protection Agency (EPA) has proposed two new rules – Multi-Pollutant Emissions Standards for Model Years 2027 and Later Light-Duty and Medium-Duty Vehicles; and Greenhouse Gas (GHG) Emissions Standards for Heavy-Duty Vehicles – Phase 3.
- If the new proposed rules are accepted, the EPA estimates that 67% of new sedans, crossovers, SUVs and light trucks; 50% of new vocational vehicles (like buses and garbage trucks); 35% of new short-haul freight tractors; and 25% of new long-haul freight tractors will be electrified by 2032 – nine years from now.
- The Multi-Pollutant Emissions Standards seek to use advances in clean car technology to reduce pollution, improve public health, and save money through reduced fuel and maintenance costs.
- The projected net benefits of this proposal range from \$850 billion to \$1.6 trillion between 2027-2055. It is also expected to avoid 7.3 billion tons of CO₂ emissions through 2055— equivalent to eliminating all GHG emissions from the current U.S. transportation sector for four years.
- The GHG Emissions Standards proposal, if accepted, will be applicable to heavy-duty vocational vehicles (such as delivery trucks, refuse haulers, public utility trucks, transit, shuttle, school buses, etc.) and tractors (such as day cabs and sleeper cabs on tractor-trailer trucks). The new rules include stricter measures for carbon dioxide emissions.
- The heavy-duty proposal is projected to avoid 1.8 billion tonnes of carbon dioxide through 2055, equal to eliminating all greenhouse gas emissions from the current U.S. transportation sector for an entire year. The projected net benefits of this proposal range from \$180 - \$320 billion.
- **U.S. historic emissions record**
- According to an analysis by Carbon Brief, the U.S. is responsible for the largest share of historical CO₂ emissions since the start of the Industrial Revolution, at around 20%

PRELIMS

1. Earth Day

- **CONTEXT: On 22nd April 2023, the 53rd anniversary of Earth Day was celebrated. Earth Day is an international event celebrated around the world to pledge support for environmental protection.**
- The theme for Earth Day 2023 is "Invest In our Planet".

- Background: Earth Day was first observed in 1970 when 20 million took to the streets to protest environmental degradation on the call of US Senator Gaylord Nelson.
 - ✓ The event was triggered by the 1969 Santa Barbara oil spill, as well as other issues such as smog and polluted rivers.
 - ✓ In 2009, the United Nations designated 22nd April as 'International Mother Earth Day'.
- About: Earth Day is now globally coordinated by EARTHDAY.ORG, which is a non-profit organization. It was formerly known as Earth Day Network.
 - ✓ It aims to "build the world's largest environmental movement to drive transformative change for people and the planet".
 - ✓ It recognizes a collective responsibility, as called for in the 1992 Rio Declaration (Earth Summit), to promote harmony with nature and the Earth to achieve a just balance among the economic, social and environmental needs of present and future generations of humanity.
 - ✓ The landmark Paris Agreement, which brings almost 200 countries together in setting a common target to reduce global greenhouse emissions, was also signed on Earth Day 2016.
- **Other Important Days**
 - ✓ 22nd March: World Water Day
 - ✓ 22nd April: Earth Day
 - ✓ 22nd May: World Biodiversity Day
 - ✓ 5th June: World Environment Day
 - ✓ Earth Overshoot Day
- **Earth Hour**
 - Earth Hour is the World Wildlife Fund for Nature (WWF)'s annual initiative that began in 2007. It is held every year on the last Saturday of March.
 - It encourages people from more than 180 countries to switch off the lights from 8.30 pm to 9.30 pm as per their local time.
 - It seeks to raise awareness about climate change and the need to save the environment.

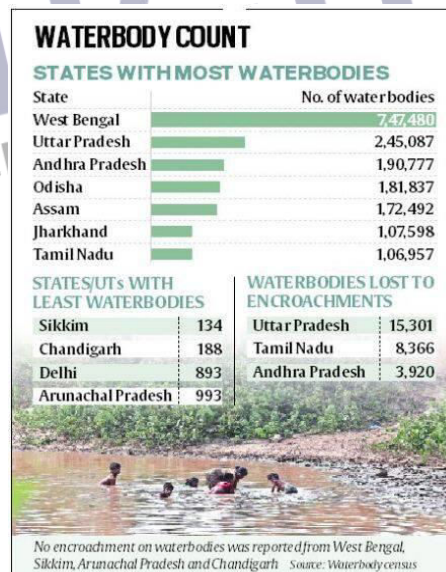
2. Census of Waterbodies in India

➤ **CONTEXT: The Ministry of Jal Shakti released the first census of waterbodies in India.**

- The census defines a waterbody as "all natural or man-made units bounded on all sides with some or no masonry work used for storing water for irrigation or other purposes.
- Waterbodies are usually of various types known by different names like tank, reservoirs, ponds and bundhies etc.
- A structure where water from ice-melt, streams, springs, rain or drainage of water from residential or other areas is accumulated or water is stored by diversion from a stream, nala or river will also be treated as waterbody.
- The waterbodies census was conducted along with the 6th Minor Irrigation Census for 2017-18.
- The results of the census have been released recently.

➤ **Findings**

- 24,24,540 water bodies have been enumerated in the country, out of which 97.1% (23,55,055) are in rural areas and only 2.9% (69,485) in urban areas.
- The data of water bodies up to the fifth minor irrigation census is limited to village level whereas the first census of water bodies covers all types of water bodies in both rural and urban areas.
- 59.5% (14,42,993) of water bodies are ponds, followed by tanks (15.7% i.e., 3,81,805), reservoirs (12.1% i.e., 2,92,280), water conservation schemes/percolation tanks/check dams (9.3% i.e. 2,26,217), lakes (0.9% i.e. 22,361) and others (2.5% i.e. 58,884).
- West Bengal accounts for the most (7.47 lakh) and Sikkim the least (134) number of water bodies.
- West Bengal has the highest number of ponds and reservoirs, whereas Andhra Pradesh has the highest number of tanks.
- Tamil Nadu has the highest number of lakes and Maharashtra is the leading state with water conservation schemes."
- West Bengal's South 24 Parganas has been ranked as the top district having the highest (3.55 lakh) number of water bodies across the country.
- The census also collected data on encroachment of water bodies for the first time. 1.6% water bodies are reported to be encroached, out of which 95.4% are in rural areas and remaining 4.6% in urban areas.



ANSWER WRITING

Q. "Compassion and tolerance are not a sign of weakness, but a sign of strength." What does this quote mean in the present context?

Introduction

This quote suggests that having compassion and tolerance towards others, even in difficult or challenging situations, does not make a person weak. Instead, it implies that showing empathy and understanding towards others, even those with different beliefs or opinions, requires a great deal of inner strength and emotional maturity.

Body

- In today's world, where power is considered to as the weapon of the strong. That is, to the extent that one can dominate others, is the extent to which he or she is powerful. But this understanding of power has been shown to be inadequate and even misleading by the likes of none other than Gandhiji, Nelson Mandela and Martin Luther king.
- For Gandhiji, non-violence is the weapon of the strong. Whenever any situation of conflict arises, we have 2 options- either to lash out in anger and emotions or to be cool and compassionate and try to work around the issue. In the contemporary context, the perception is such that the former response is often seen as assertive and desirable while the latter is dismissed as being timid and weak. But before arriving at such premature conclusions, we must pause and ask ourselves the utility of a belligerent response and if we really need it. Most of the time, we'd find that a balanced, tolerant, and sensitive approach works much better.
- Compassion and tolerance can be a strength as they allow individuals to understand and empathize with others' struggles and viewpoints, which can foster stronger relationships and create a more supportive environment. These qualities can serve as a binding force to keep our society intact.

Conclusion

- By being compassionate and tolerant, one can handle situations in a more peaceful and constructive manner, rather than reacting with anger or aggression. This approach can lead to more positive outcomes, as it promotes understanding and cooperation instead of conflict and hostility.

MCQs

1. Consider the following statements with reference to Human Genome Project
 1. It was a UN funded project that ended in 2003 which was started in 1990.
 2. It is the first ever attempt to sequence human genome.
 Which of the above statement/s is/are correct?
 - a) 1 only
 - b) **2 only**
 - c) Both 1 and 2
 - d) Neither 1 nor 2
2. With reference to agriculture in India, how can the technique of 'genome sequencing', often seen in the news, be used in the immediate future?
 1. Genome sequencing can be used to identify genetic markers for disease resistance and drought tolerance in various crop plants.
 2. This technique helps in reducing the time required to develop new varieties of crop plants.
 3. It can be used to decipher the host-pathogen relationships in crops.

Select the correct answer using the code given below:

- a) 1 only
 - b) 2 and 3 only
 - c) 1 and 3 only
 - d) **1, 2 and 3**
3. Consider the following statements with respect to the Genome India Project (GIP)
 1. It is a sub initiative under Human Genome Project.
 2. It aims to form a grid of representative Indian genome after collecting 10,000 samples in the first phase from across India.
 3. This would aid our understanding of the nature of diseases affecting the Indian population.

Which of the statements given above is/are correct?

- a) 1 and 2 only
 - b) 3 only
 - c) 1 and 3 only
 - d) **2 and 3 only**
4. Consider the following statements:
 1. The CRISPR technology replicates a natural defence mechanism in some bacteria that use a similar method to protect themselves from virus attacks.
 2. Feluda test for COVID-19 uses indigenously developed CRISPR gene-editing technology to identify and target the genetic material of SARS-CoV2.

3. CRISPR-Cas9 technology enables geneticists and medical researchers to edit parts of the genome in a very precise manner.
4. CRISPR technology can be used to control the growth of mosquitoes.

Which of the statements given above is/are correct?

- a) 1 and 3 only
- b) 2, 3 and 4 only
- c) 1, 2 and 3
- d) 1,2,3 and 4**

5. Which among the following is/are gene editing technologies:

1. TALEN
2. Zinc-Finger Nucleases (ZFNs)
3. Meganucleases
4. SHANEL

Select the correct answer code:

- a) 1, 2 and 3 only**
- b) 2 and 3 only
- c) 1, 3 and 4 only
- d) 1,2 and 4 only

6. Consider the following statements about Koronivia Joint Work on Agriculture (KJWA):

1. It is a landmark decision under the United Nations Environment Programme (UNEP) that recognizes the unique potential of agriculture in tackling climate change.
2. It resonates with FAO's core mandate to eliminate hunger, food insecurity, and malnutrition.

Select the correct answer using the codes given below:

- a) 1 only
- b) 2 only**
- c) Both 1 and 2
- d) Neither 1 nor 2

7. Consider the following statements with reference to recently conducted water census in India

1. The report is the first census of waterbodies released by the Ministry of Jal Shakti.
2. The census defines a water body as all natural units only bounded on all sides with some or no masonry work used for storing water for.
3. Pradhan Mantri Krishi Sinchayee Yojana (PMKSY) provides for the restoration of water bodies.

Which of the above statement/s is/are correct?

- a) 1 and 2 only
- b) 2 and 3 only
- c) 1 and 3 only
- d) 1,2 and 3**

8. PRAYAG platform recently seen in news is related to which of the following Ministry?

- a) Ministry of Jal shakti**
- b) Ministry of Home Affairs
- c) Ministry of Environment Forest and Climate Change
- d) Ministry of Finance

9. "Exobiology Extant Life Surveyor (EELS)" is a snake-like, self-propelled robot often mentioned in news is associated with which of the following organization?

- a) NASA**
- b) ROSCOSMOS
- c) JAXA
- d) ISRO**

10. Which of the following statement/s is/are correct with regards to the term "Zombie Banks" often mentioned in News?

1. It is a bank that is practically insolvent but continues to exist through hiding bad loans on their balance sheet.
2. Zombie banks resort to forbearance lending i.e. allows a borrower to permanently stop or suspend payments of the loan

Which of the above statement/s is/are correct?

- a) 1 only**
- b) 2 only
- c) Both 1 and 2
- d) Neither 1 nor 2