IAS MAINS 2020/2021

MINED FROM THE TREASURE TROVE OF LSD

GS – III ... SCIENCE AND TECHNOLOGY ... PART 1

FROM THE ARCHIVES

MODULE – 9

EXCLUSIVE

GS – III ... SCIENCE AND TECHNOLOGY

1 What do you understand by Genome India Project? What is the problem when we rely on genome data of the Western Countries? How does the Genome India Project benefit India?

EDITORIAL – 523 / 13th Feb, 2020

HINTS

GENOME INDIA PROJECT

- It is to map the diversity of Indian population.
- The project is described as "the first scratching the surface of the vast genetic diversity of India".
- Rs. 238 Cr Genome India Project will involve 20 leading institutions, including IISc, Bengaluru and a few IITs. IISc Centre for Brain Research will serve as the nodal point.
- The 1st stage will look at the samples of 10,000 persons from all over the country to form a grid that will enable the development of a reference genome.
- Genome mapping means figuring out the location of a specific gene on a particular region of the chromosome.

WHAT IS THE PROBLEM WHEN WE RELY ON AVAILABLE DATA?

- Over 95% of the genome samples available are of white Caucasian (European origin).
- Based on these samples, cutting edge research in medicine and pharmacology has been done.
- Hence, the development of medicines / vaccines may not truly reflect the needs of other groups.

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WHY INDIAN PROJECT IS SIGNIFICANT?

- First migration of humans took place from Africa to India and then there were several waves of migration that provided vast horizontal diversity through inter-mixing of races. Moreover, endogamy (marriages within the caste) was practiced over many generations.
- It helps to get sharper understanding of diseases transmitted genetically down the line as well as to understand the disease burden of complex disorders.

HOW DOES IT BENEFIT INDIA?

- By mapping the diversity of India's genetic pool, it is expected to lay foundations for personalized medicine.
- It is expected to enable greater medicinal efficiency in terms of preventive interventions and customized treatment.
- Once we have genetic mapping, it may be possible to take action before the onset of diseases like Diabetes, Mental health disorders etc.

GS III – SCIENCE AND TECHNOLOGY

2 How the newly created New Space India Limited (NSIL) is different from Antrix Corporation. How IN-SPACe plans to ensure level playing field?

EDITORIAL – 361 / 29th Nov, 2019

HINTS

ANTRIX CORPORATION

- For the past several years, ISRO has commercialization arm, Antrix Corporation that looks at foreign markets.
- It brings business in the form of several small satellites of foreign countries being launched from the Indian soil by ISRO.
- It is relatively successful. Now, the Government idea is to expand the space operations into the private sector.
- Moreover, ISRO's capabilities expanded and collaboration with industries is on increase. Hence, there is a need to expand the commercialization activities domestically. Hence NSIL was born.

ROLE OF NSIL

- Its primary aim is to commercially exploit the R&D work of ISRO by taking it to the private sector.
- The private sector involvement will enhance as we go forward, because at present, our contribution to global space industry is just 2%.
- The activities planned by NSIL
  - ✓ Small Satellites Technology Transfer to private industry.
  - ✓ Manufacture of SSLV in collaboration with private sector.
  - ✓ Producing PSLV through the Indian industry.
- It would spur the growth of Indian industries/start-ups in the space sector.

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'IN–SPACe' AND ENSURING LEVEL PLAYING FIELD

- Private sector participation in Indian Space sector is one of the lowest. Hence, to boost private sector participation and create level playing field for private companies to use Indian space infrastructure, 'IN–SPACe' was created.
- It facilitates fruitful dissemination of space technologies to students, researchers, academic bodies by increasing their access to space assets, to make India a global technology powerhouse in space arena.
- It is to encourage policies and friendly regulatory environment in space sector.
- It permits establishment of facilities by private entities within ISRO premises subject to safety norms.
- It will function autonomously and parallel to ISRO, without taking away anything from it.

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3 How the Quantum Computing is different from Classical Computing? Define the terms "Quantum Superposition" and "Quantum Entanglement". What are India's efforts towards Quantum Computing?

EDITORIAL – 453 / 7th Jan, 2020

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QUANTUM COMPUTING

- Quantum bits or Qubits can have multiple values or states for 0 and 1.
- It enables them to store different types of information.
- Superposition and Entanglement are two fundamental properties of quantum objects. The ability to manipulate these properties makes quantum algorithms fundamentally different from classical algorithms.

CLASSICAL COMPUTING

- Here bits can take on a value of either '0' or '1'.
- All information is stored and read as a consequence of 0s and 1s.
- 0 is 'Off' and state of 1 is 'On'.
- These are conventional binary computers.

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EDITORIAL – 453 / 7th Jan, 2020

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QUANTUM SUPERPOSITION

- Normal classical computers can take the state of 0 or 1.
- A Qubit may be a superposition of both the states. It is the ability of a quantum system to be in multiple states at the same time until it is measured.
- An unobserved photon exists in all possible states simultaneously, but when observed / measured, it exhibits only one state.

QUANTUM ENTANGLEMENT

- Quantum state of each particle cannot be described independent of the state of the others, even when the particles are separated by a large distance.
- Entangled particles remain connected so that, actions performed on one affect the other, even when separated by great distances.

ADVANTAGES OF QUANTUM COMPUTERS

- The Speed and capability will increase.
- They require less physical space.
- Energy requirements will be reduced.
- Real world problems can be tackled faster.
- They can tackle the complex problems that are beyond the scope of classical computers.

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INDIA'S EFFORTS

- Government launched two initiatives:
  - A networked program on Quantum Information Science & Technology (QuST)
  - The National Mission on Quantum Technologies and Applications (NM-QTA)
- Broad Objectives of QuST include –
  - Development and demonstration of quantum computers, quantum communication & cryptography.
  - Development of quantum-enhanced and inspired technology.
  - Development of advanced mathematical quantum techniques, algorithms and theory of quantum information systems.
- The Government in its Budget 2020 has announced NM-QTA with a total outlay of Rs. 8,000 Crore for a period of five years.
- Quantum computers and computing, quantum communication, quantum key distribution, encryption, crypt analysis, quantum devices, quantum sensing etc., are the thrust areas.
- Complex problems like Weather forecasting, drug discovery, financial modelling etc. can be solved with Quantum Computing.

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4 Explain the terms 'Nanobots' and 'Carbon Nanotubes' with their applications.

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ABOUT NANOBOTS

These are tiny robots created with nano materials. They carry out specific functions and are around 50 to 100 nm wide. They can also be made of bio-degradable nano materials.

APPLICATIONS OF NANOBOTS

- They can be used very effectively for drug delivery. Normally, drugs work through the entire body before they reach the disease-affected area. Using nanobots, the drug can be targeted to a precise location, which would make the drug much more effective and reduce the chances of possible side effects.
- Special sensor nanobots can be inserted into the blood under the skin where microchips, coated with human molecules and designed to emit an electrical impulse signal, monitor the sugar level in the blood.
- They can flow in our blood and do the tasks like removing arterial plagues, dissolving clots, monitoring the condition of heart, liver, kidneys, detecting and eradicating cancer cells etc.

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ABOUT CARBON NANOTUBES

- These are cylindrical molecules that consist of rolled up sheets of single layer carbon atoms (Graphene) or by rolling up multiple sheets of Graphene.
- Their mechanical tensile strength can be 400 times that of Steel.
- They are very light in weight. Their density is 1/6th that of Steel. Their thermal conductivity is better than that of Diamond.

APPLICATIONS OF CARBON NANOTUBES

- These can be deployed in cars, clothes, air planes or solar panels. Creating stain resistant shirts, lighter and fuel efficient cars and planes and scratch resistant paints are possible with Carbon Nanotubes.
- CNTs have been successfully applied in pharmacy and medicine.
- They are already being used to control or enhance conductivity in polymers.
- As they are highly electrically conductive, they have the ability to be a cost-effective replacement for metal wires.
- Their semiconducting properties make them candidates to replace existing computer chips.

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