

## **Cell-Free DNA**

**Source: TH** 

### Why in News?

A notable advancement in medical science has emerged in recent years **through the discovery of cell-free** <u>Deoxyribonucleic Acid</u> (cfDNA), carrying significant implications for **disease detection**, **diagnosis**, and treatment.

• cfDNA stands poised to reshape the entire landscape of medical science.

## What is Cell-Free DNA (cfDNA)?

#### About:

- cfDNA refers to fragments of DNA that exist outside of cells, specifically in various body fluids. Unlike the majority of DNA which is enclosed within cells.
- Scientists have been aware of cfDNA since 1948, but only in the last two decades have they figured out what to do with it.
- cfDNA is released into the **extracellular environment** under different circumstances, including **cell death or other cellular processes**.
- These cfDNA fragments contain <u>genetic information</u> and can offer insights into a person's health status, potential diseases, and genetic variations.

## Applications:

- Non-Invasive Prenatal Testing (NIPT):
  - Cell-free DNA serves as a valuable tool for screening <u>chromosomal</u> <u>abnormalities</u> in developing foetuses, such as Down syndrome.
  - NIPT replaces invasive procedures such as amniocentesis, minimizing risks for both expectant mothers and foetuses.
  - Analysis of cfDNA in maternal blood provides crucial information about the foetus's genetic health.
- Early Cancer Detection:
  - Identifying cancers at their initial stages for prompt treatment.
  - The 'GEMINI' test utilizes cfDNA sequencing to detect lung cancer with high accuracy.
  - Combining cfDNA analysis with existing methods enhances overall cancer detection.
- Monitoring Organ Transplants:
  - Donor-derived cfDNA offers a promising approach to monitor the health and acceptance of transplanted organs.
  - Fluctuations in cfDNA levels can **indicate organ rejection or acceptance** before other markers become evident.
  - Early detection of rejection allows for timely intervention and improved outcomes in

organ transplantation.

#### Neurological Disorder Biomarkers:

- Investigating cfDNA's potential as a biomarker for neurological disorders.
- Aiding in the diagnosis and monitoring of conditions like <u>Alzheimer's</u> disease, neuronal tumours, and stroke.
- Metabolic Disorder Insights:
  - Exploring cfDNA's role as a biomarker for metabolic disorders.
  - Detection and management of conditions such as <u>type-2 diabetes</u> and nonalcoholic fatty liver disease.
- Advancing Disease Research:
  - Researchers use cfDNA analysis to study disease mechanisms, monitor treatment effectiveness, and gain insights into disease pathways.
  - The versatility of cfDNA applications contributes to a deeper understanding of complex diseases and their underlying genetic factors.

## **UPSC Civil Services Examination, Previous Year Questions (PYQs)**

#### **Prelims**

# Q. With reference to the recent developments in science, which one of the following statements is not correct? (2019)

- (a) Functional chromosomes can be created by joining segments of DNA taken from cells of different species.
- **(b)** Pieces of artificial functional DNA can be created in laboratories.
- (c) A piece of DNA taken out from an animal cell can be made to replicate outside a living cell in a laboratory.
- (d) Cells taken out from plasma and animals can be made to undergo cell division in laboratory petri dishes.

#### Ans: (a)

- In 2017, US researchers were successful in developing new semi-synthetic strain of E. coli bacteria that is a living organism that incorporates both natural and artificial DNA and is capable of creating entirely new, synthetic proteins
- A wide variety of double stranded DNA templates are replicated extensively in an in-vitro DNA replication system containing purified proteins.
- Through micro propagation, plants can be developed in the laboratory, for instance, chlamydomnas cells can be replicated in culture through light variations. Therefore, option (a) is the correct answer.

# Q. With reference to agriculture in India, how can the technique of 'genome sequencing', often seen in the news, be used in the immediate future? (2017)

- 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)1only

(b)2and3only

(c) 1 and 3 only

(d) 1, 2 and 3

## Ans: (d)

- Chinese scientists decoded rice genome in 2002. The Indian Agricultural Research Institute (IARI) scientists used the genome sequencing to develop better varieties of rice such as Pusa Basmati-1 and Pusa Basmati-1121, which currently makes up substantially in India's rice export.
- In genome sequencing it takes less time. The genome sequencing enables the study of the entire DNA sequence of a crop, thus it aids in understanding of pathogens' survival or breeding zone.

