Deoxyribonucleic Acid (DNA) AND Ribonucleic Acid (RNA)

Why in news?

Increasing variants of the covid-19 virus and their consequences on humans.

What is DNA?

- **Genetic carrier** -Deoxyribonucleic acid (DNA) is the molecule that carries genetic information for the development and functioning of an organism.
- **Two strands** -DNA is made of two linked strands that wind around each other to resemble a twisted ladder a shape known as a double helix.
    - Each strand has a backbone made of alternating sugar (deoxyribose) and phosphate groups
- The two strands are connected by chemical bonds called bases.
- **Four bases** -Adenine (A), cytosine (C), guanine (G) or thymine (T).
- **Proofreading** -The enzymes responsible for copying DNA, collectively known as DNA polymerases, possess error-correction property, known as 'proofreading'.

What is RNA?

- Ribonucleic acid (RNA) is a nucleic acid present in all living cells that has structural similarities to DNA
- RNA is most often single-stranded
- An RNA molecule has a backbone made of alternating phosphate groups and the sugar ribose
- Attached to each sugar is one of four bases: adenine (A), uracil (U), cytosine (C) or guanine (G)
- Different types of RNA in cells are messenger RNA (mRNA), ribosomal RNA (rRNA) and transfer RNA (tRNA).
- Some RNAs are involved in regulating gene expression.
- RNA polymerases do not possess the ability to proofread

What is the difference between DNA and RNA viruses?

DNA Virus	RNA Virus
• The DNA virus include the members of the pox family (smallpox and chickenpox) and Hepatitis B.	• The RNA virus include COVID-19, AIDS, polio, influenza, dengue, chikungunya, Ebola, Zika.
• DNA viruses contain DNA as their genetic material	• RNA viruses contain RNA as their genetic material

• Double-stranded DNA viruses are more common than single-stranded DNA viruses	• Single-stranded RNA viruses are more common than double-stranded RNA viruses.
• Viral DNA is replicated inside the nucleus of the host cell	• Viral RNA is first transcribed and then is replicated in the cytoplasm
• DNA viruses are stable due to the lower mutation rate.	• RNA viruses are unstable due to the higher mutation rate
• DNA viruses shows an accurate replication.	• RNA viruses shows an error-prone replication

Why most viruses are RNA based?

- Most viruses are RNA based because
  - They can encode their replication machinery
  - High mutation rates
  - Error-prone nature of their polymerases
  - Acquire multiple adaptations
  - Can exist in multiple variant forms simultaneously in each host

What are the consequences of RNA viruses?

- **Survival advantage** -Few odd variants possesses a survival advantage against a vaccine or a drug.
- Such variants will undergo further natural selection and the virus will continue to proliferate.
- **Short generation time** - In a very short period after infection the host's virus population becomes enormous.
- **Affects immune system** -High viral output together with the diversity overwhelms the immune system.
- **Zoonosis** –The viruses can jump across species resulting in zoonosis.
- **Spread easily among newer hosts** -Because the high error rate and the short generation time enable the virus to adapt to newer conditions much faster.

A zoonosis (zoonotic disease) is an infectious disease that is transmitted between species from animals to humans (or from humans to animals).

References

1. The Hindu │RNA Virus
2. National Human Genome Research Institute │DNA Virus
3. ThoughtCo



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