Nobel Prize in Chemistry 2024

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Why in News?

Recently, the **Royal Swedish Academy of Sciences** awarded the **Nobel Prize in Chemistry 2024.**

- **One half** of the prize was given to **David Baker** for **computational protein design** while the **other half** was jointly given to **Demis Hassabis and John M. Jumper** for **protein structure prediction.**

What is the Contribution of David Baker?

- **Revolutionising Protein Engineering**: Baker's research group has used **computational methods** to design **novel proteins** from scratch, reshaping the possibilities of **protein engineering.**
    - By manipulating the **20 different amino acids** that form proteins, his team has created **new proteins** that do not exist in nature.
- **Applications in Medicine and Technology**: These artificially designed proteins have vast potential, particularly in the development of **pharmaceuticals, vaccines, nanomaterials, and biosensors**.
    - Baker has successfully designed proteins with new functions, like **degrading plastics** or performing tasks beyond the capabilities of natural proteins.
- **First Breakthrough in 2003**: Baker's first major success came in **2003** when his team designed a **protein completely different** from any found in nature.

What is the Contribution of Demis Hassabis and John Jumper?

- **Protein Folding Problem**: Since the 1970s, scientists have **struggled** to predict how **strings of amino acids fold** into their **three-dimensional shapes**.
    - The structure of a protein is crucial because it **determines its function**.
    - Understanding these structures is essential for advances in fields like **drug discovery, disease treatment, and biotechnology.**
- **Breakthrough with AlphaFold2**: In 2020, **Hassabis and Jumper** introduced **AlphaFold2, an AI-driven system** that revolutionised protein **structure prediction.**
    - The model was able to **predict** the structure of nearly **every known protein, approximately 200 million.**
    - This achievement solved a **50-year-old problem** in structural biology.
    - **Traditional approaches** to decoding protein structures, such as **x-ray crystallography**, are slow, laborious, and time-consuming.
- **Widespread Use and Impact**: AlphaFold2 has been used by over **two million researchers** worldwide, enabling breakthroughs in numerous fields.
    - For example, it has been instrumental in understanding **antibiotic resistance** and creating **enzymes capable of breaking down plastics**.

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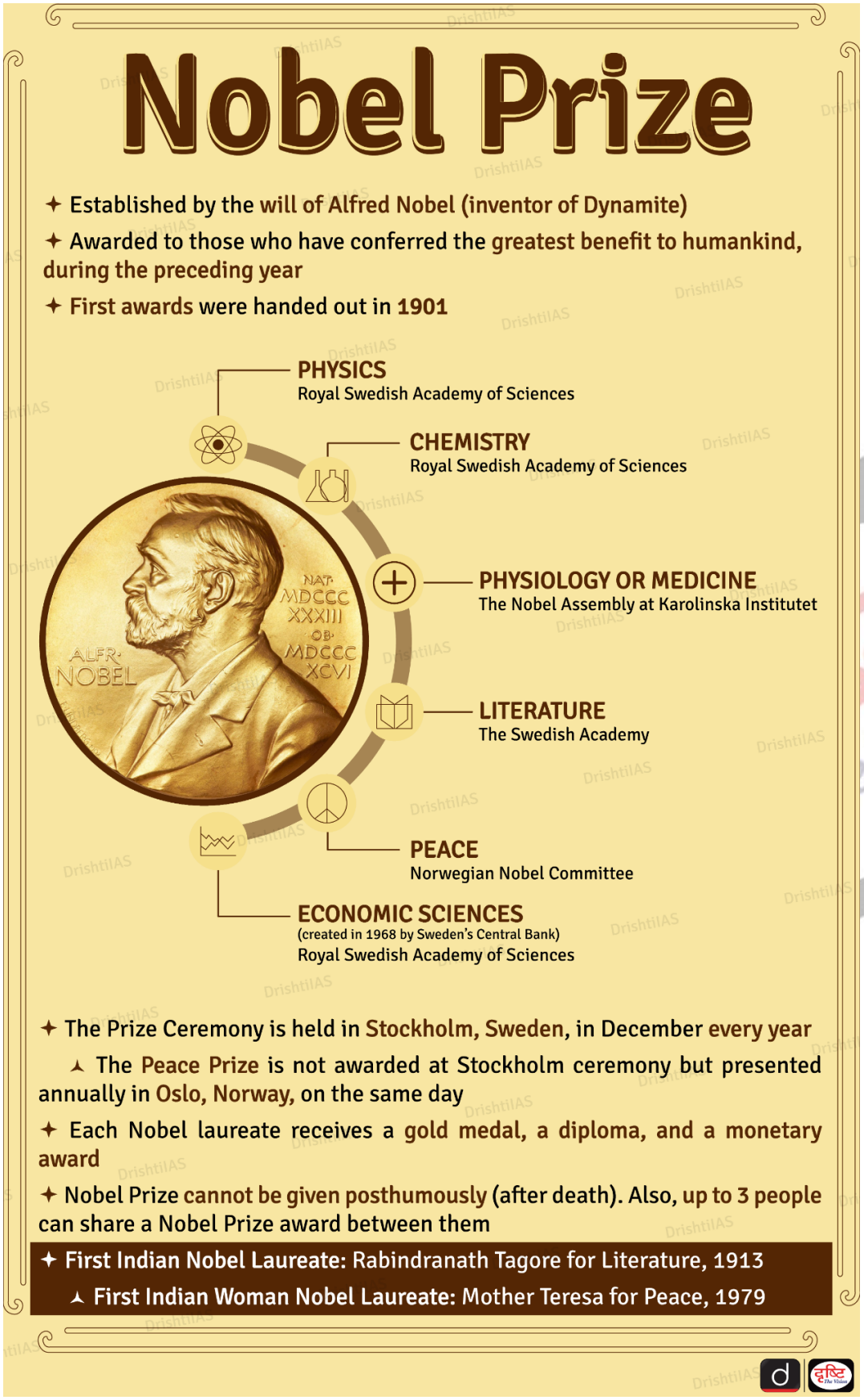
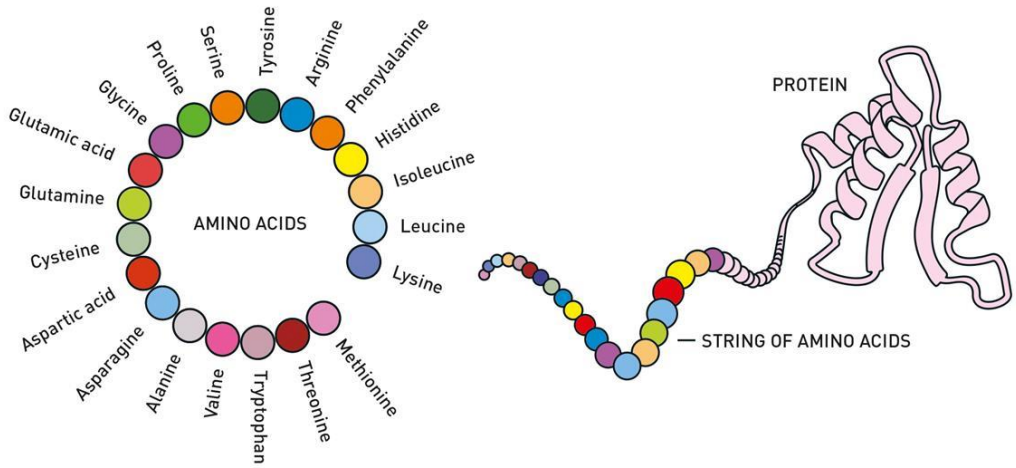


What are Key Facts About Proteins?

- **Amino Acids as Building Blocks**: Proteins are made up of **long chains of amino acids**, which are **organic molecules** containing **carbon, hydrogen, nitrogen, oxygen**, and sometimes sulphur.

    - There are **20 different amino acids**, and different combinations of these, **folded** into **three-dimensional structures**, form the various proteins needed for biological processes.
- **Structural Role of Proteins**: The three-dimensional structure of a protein determines its function.
    - In 1972, Nobel Prize in Chemistry was given to **Christian Anfinsen** for his work on **ribonuclease**, especially concerning the **connection between the amino acid sequence.**
- **Proteins as Essential Molecules**: Proteins are **fundamental** to virtually every biological process in living organisms and perform diverse functions such as speeding up **biochemical reactions**, providing structural support, aiding in **immune responses,** and storing nutrients.



UPSC Civil Services Examination, Previous Year Questions (PYQs)

Prelims

Q. With the present state of development, Artificial Intelligence can effectively do which of the following? (2020)

1. Bring down electricity consumption in industrial units
2. Create meaningful short stories and songs
3. Disease diagnosis
4. Text-to-Speech Conversion
5. Wireless transmission of electrical energy

Select the correct answer using the code given below:

(a) 1, 2, 3 and 5 only

(b) 1, 3 and 4 only

(c) 2, 4 and 5 only

(d) 1, 2, 3, 4 and 5

Ans: (b)