



DNA Nano Rafts

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Why in News?

A study published in Nature Materials has introduced a revolutionary technique using **DNA Nanorafts** to create **Artificial Cells** that can work like [biological membranes](#).

- These programmable nanostructures can **reshape membranes, form pathways, and react to surroundings**, advancing **medicine, biosensors, and artificial life research**.

What is DNA Nanorafts?

- **DNA Nanorafts:** [DNA \(Deoxyribonucleic Acid\)](#) nano-rafts are **tiny, flat structures** made from **DNA strands** which can be **programmed to control the shape and permeability of cell membranes in response to specific chemical signals**.
 - This ability allows them to **influence cell-like membranes in a controlled way**.
- **Working Mechanism:**
 - **Attachment to Model Membranes:** DNA nanorafts attach to **Giant Unilamellar Vesicles (GUVs)**, which serve as **simplified models** of biological cell membranes.
 - **GUVs are artificial, cell-sized lipid membranes that mimic real cell membranes**, making them useful for studying **membrane behavior and transport mechanisms in synthetic biology**.
 - **Shape Modification & Reversibility:** DNA nanorafts **expand** when "unlocking" DNA strands are added, **altering the membrane's shape**.
 - This unlocking can be triggered by **enzymes, mechanical devices, or other methods**. The process is **reversed** by adding "locking" DNA strands, restoring the original shape.
 - **Locked Nucleic Acid (LNA)** helps **secure DNA strands together** for stability.
 - **Controlled Membrane Manipulation:** This technique allows scientists to precisely control artificial cell membranes.
- **Key Functions:**
 - **Cell Shaping:** Nanorafts can **alter the structure of [synthetic cell membranes](#)**, which is essential for **cell movement, division, and communication**.
 - **Gatekeeping (Molecular Transport):** They create **temporary channels in the membrane**, allowing **molecules to pass through**.
 - These channels can **open and close as needed**, similar to **natural protein-based channels in living cells**.

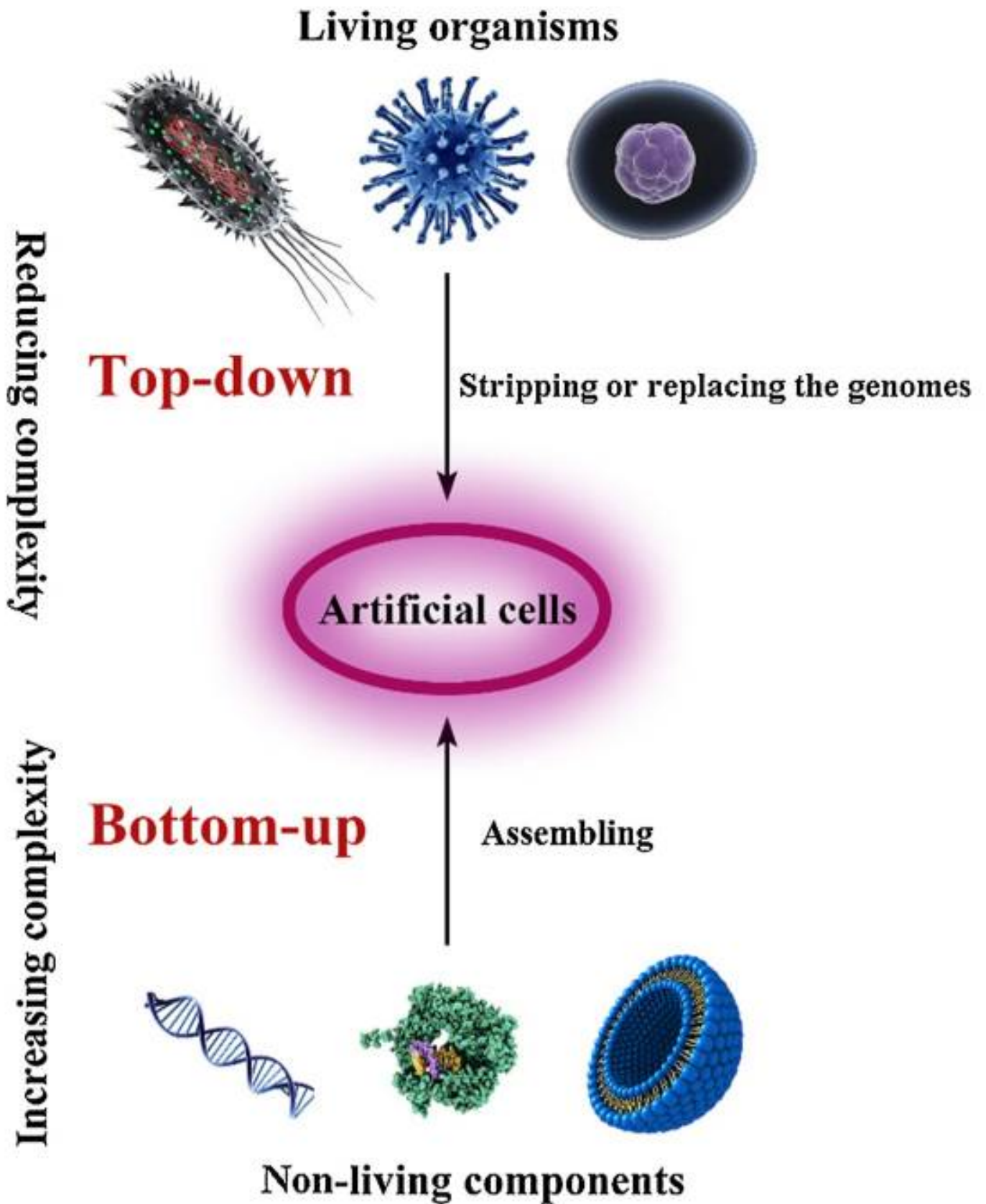
What is an Artificial Cell?

- **About:** Artificial cells are **synthetic structures that mimic living cells** but are made from **non-living components** like synthetic membranes and chemicals.
- **Creation:** Synthetic cells can be created using 2 main approaches:
 - **Top-down approach:** Scientists start with a living cell, remove non-essential genes, and retain only core functions. **Eg: Mycoplasma mycoides JCVI-syn3.0 (minimal synthetic**

cell).

- **Bottom-up approach:** Researchers **build a cell-like structure from the ground up** by **combining biological and non-biological molecules** to replicate key cellular functions. Eg: **GUVs**

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- Applications:

- **Drug Delivery:** Synthetic cells can be designed to **transport and release medicines at specific targets** in the body.
- **Biomedicine:** They can aid in **developing innovative therapies** for chronic diseases such as **cancer**.
- **Organ Transplantation:** It could help in creating **bioengineered tissues or organs**, addressing the shortage of donor organs.

UPSC Civil Services Examination Previous Year Question

Q. Consider the following statements:

1. Genetic changes can be introduced in the cells that produce eggs or sperms of a prospective parent.
2. A person's genome can be edited before birth at the early embryonic stage.
3. Human induced pluripotent stem cells can be injected into the embryo of a pig.

Which of the statements given above is/are correct?

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

Ans: (d)

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