



Synthetic Biology

For Prelims: Synthetic Biology, Applications of Synthetic Biology, Different National and International Laws and Conventions.

For Mains: Biotechnology, Scientific Innovations & Discoveries, intellectual property rights, National Policy on Synthetic Biology

Why in News?

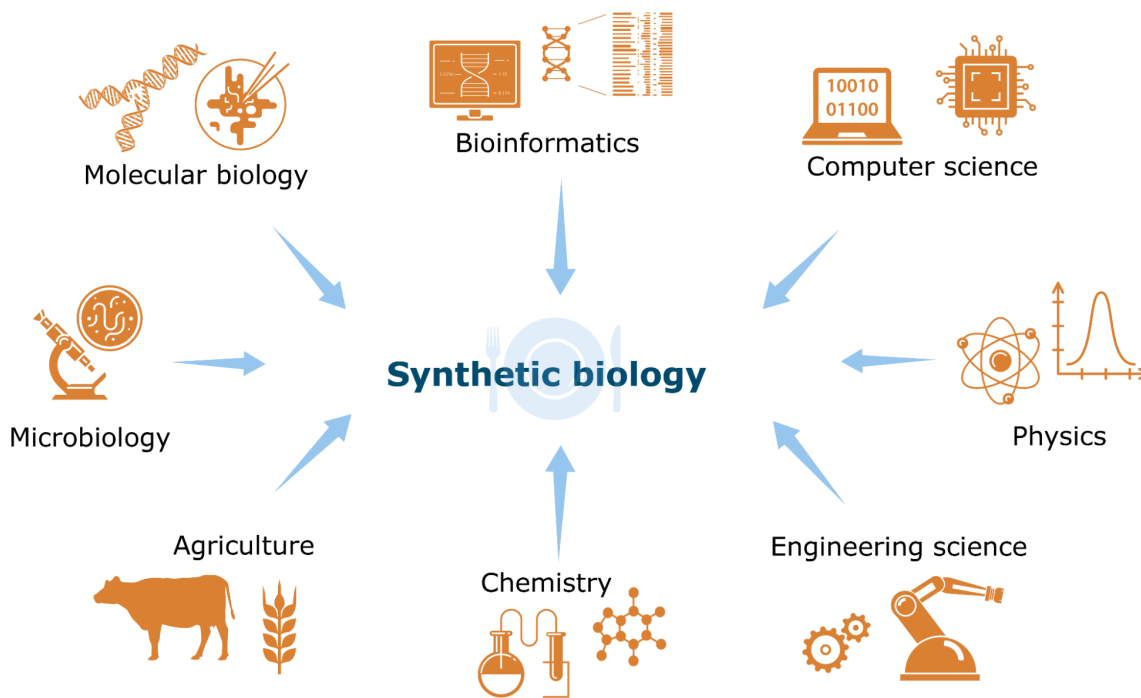
Recently, the **Department of Biotechnology**, Ministry of Science & Technology released a **draft foresight paper on synthetic biology**.

- Synthetic biology has multifarious **applications of energy, agriculture and biofuels**. Thus, there is always a perceived threat of components releasing into the open environment.
- Therefore, the document stresses on the **need for a national policy** that can consolidate India's stand on the issue.

What is Synthetic Biology?

- The term 'synthetic biology' was first used by **Barbara Hobomin in 1980**, to describe bacteria that had been genetically engineered using **recombinant DNA technology**.
- Synthetic biology refers to the science of **using genetic sequencing, editing, and modification** to create unnatural organisms or organic molecules that can function in living systems.
- Synthetic biology enables scientists to design and **synthesise new sequences of DNA from scratch**.
- The term was used to describe the synthesis of **unnatural organic molecules that function in living systems**.
 - More broadly in this sense, the term has been used with reference to efforts to **'redesign life'**.

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What are Applications of Synthetic Biology?

- **Standardised Biological Parts**- identify and categorise standardised genomic parts that can be used (and synthesised quickly) to build new biological systems.
- **Applied Protein Design**- redesign existing biological parts and expand the set of natural protein functions for new processes.
 - **For e.g.**, Modified rice to produce beta-carotene (a nutrient usually associated with carrots), that prevents **Vitamin A deficiency**.
- **Natural Product Synthesis**- engineer microbes to produce all of the necessary enzymes and biological functions to perform complex multistep production of natural products.
 - For e.g, Microorganisms harnessed for **bioremediation** (use of living microorganisms to degrade environmental contaminants into less toxic forms) to clean pollutants from water, soil and air.
- **Synthetic Genomics**- design and construct a 'simple' genome for a natural bacterium.
 - For e.g, Yeast engineered to produce rose oil as an eco-friendly and sustainable substitute for real roses that perfumers use to make luxury scents.

What are Potential Negative Impacts of Synthetic Biology?

- **Negative Environmental Health:** The intentional or **accidental release of genetically engineered organisms** into the environment could have significant negative impacts on both human and environmental health.
 - **Misuse of these technologies and a failure to account for unintended consequences** could cause irreversible environmental damage.
- **Do-It-Yourself Biology:** It's a movement of "citizen scientists" interested in synthetic biology experiments that has become an international phenomenon over the last decade.
 - **Often with little prior knowledge of the field, enthusiasts meet in makeshift labs to take crash courses** in biotechnology and conduct hands-on experiments.
- **Ethical Concerns:** Many of the ethical questions relevant to synthetic biology are similar to **ethical discussions related to genome editing** like:
 - Are humans crossing moral boundaries by redesigning organisms with synthetic biology techniques?
 - If synthetic biology yields new treatments and cures for diseases, who in our society will have access to them?

What are Governance, Policy And Regulatory Aspects Relevant To Synthetic Biology?

- **International Bodies & Agreements:**
 - [Convention on Biological Diversity \(CBD\)](#)
 - Cartagena Protocol on Biosafety
 - Nagoya Protocol on Access and Benefit Sharing
 - Nagoya-Kuala Lumpur Supplementary Protocol
 - [Food and Agricultural Organisation \(FAO\)](#)
 - [Convention on International Trade in Endangered Species of Wild Fauna and Flora \(CITES\)](#)
 - [International Union for the Conservation of Nature \(IUCN\)](#)
 - [Agreement on Trade Related Aspects of Intellectual Property Rights \(TRIPS\)](#)
 - [UN Convention on the Law of the Sea \(UNCLOS\)](#)
 - [Biological Weapons Convention](#).
 - India is a **party to all the International governance bodies** discussed above.
- **Indian Regulatory System:**
 - [Drugs and Cosmetics Rules - 1988](#).
 - [Protection of Plant Varieties and Farmers' Rights Act, 2001](#).
 - [Biological Diversity Act, 2002](#)
 - [Food Safety and Standards Act 2006](#)

Way Forward

- India is yet to formally come up with its national strategy on synthetic biology (both policy and regulatory).
- In this context, India's policy and regulatory framework needs to **focus on issues like,**
- **Defining** what constitutes the science of synthetic biology.
- What kind of research and development priorities will be made for the public sector.
- **Guidance for the private sector for future research** and what all considerations will be undertaken related to relevant policy frameworks, including those in [intellectual property rights](#).
- How India will regulate the development and use of this technology, considering issues related to environment and socio-economics.
- While making a national strategy **India should consider Principles of International Law** which are:
 - The precautionary principle
 - State sovereignty and prevention of transboundary harm.
 - State responsibility and Environment Impact Assessment
 - Principles of access to information, public participation and access to justice
 - People's right to self-determination and free prior informed consent
 - Sustainable development and inter-generational equity

[Source: IE](#)