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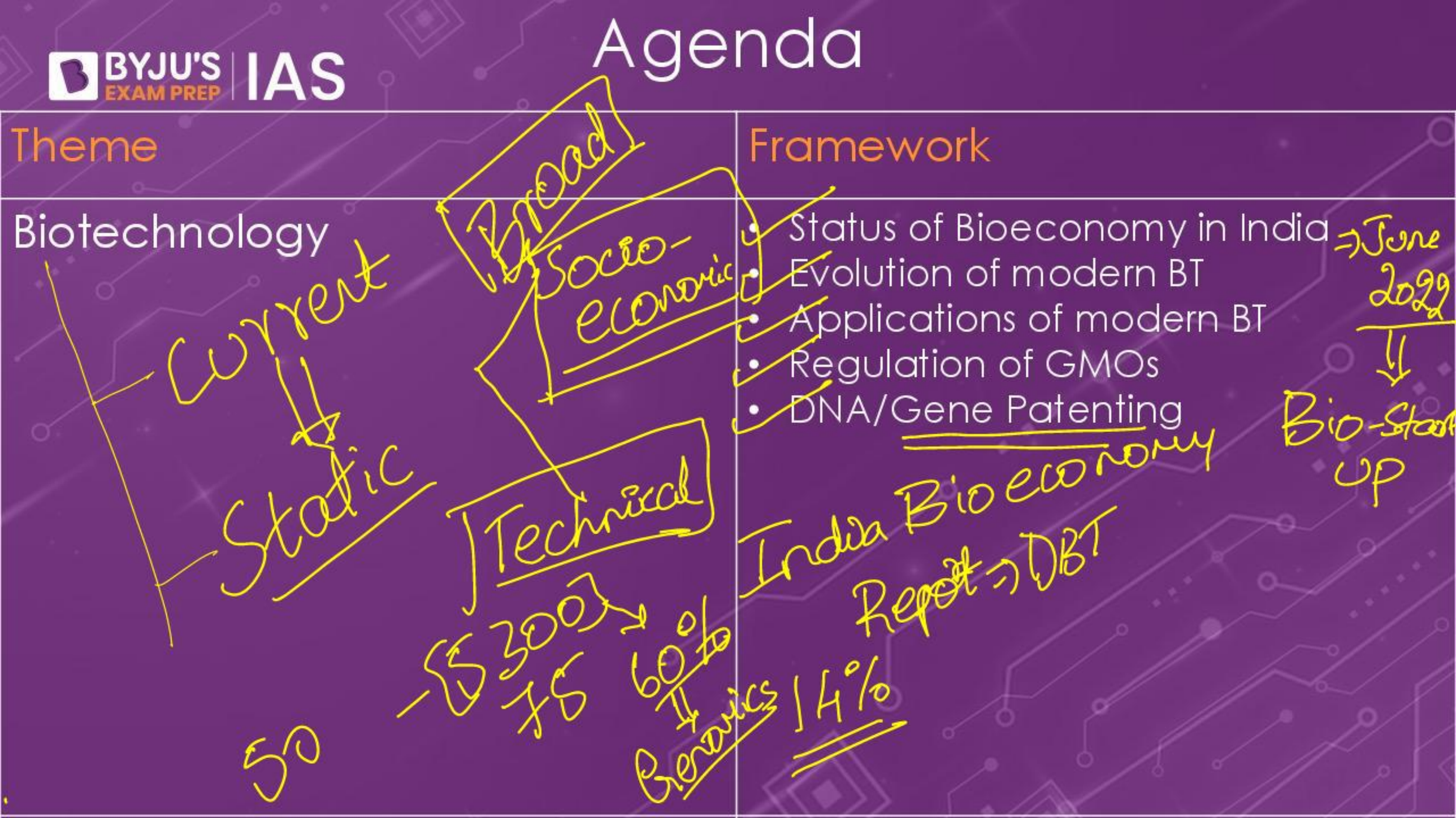
TARGET MAINS 2022

CSE MAINS QUESTIONS DISCUSSION

SCIENCE AND TECHNOLOGY-1

Agenda

Theme	Framework
Biotechnology	• Status of Bioeconomy in India • Evolution of modern BT • Applications of modern BT • Regulation of GMOs • DNA/Gene Patenting



Practice Questions

1. What are factors responsible for growth of Bioeconomy in India?

2. What are the applications of modern biotechnology? What is the role of modern biotechnology in bringing about socio-economic development in the contemporary times?

3. Harnessing modern biotechnology tools is important to achieve sustainable agriculture production. Do you agree?

4. Gene therapy is said to revolutionise medicine in the contemporary times. What is gene therapy? What are some of the important advances in the field of gene therapy in the recent times?

5. What is the role of Genomics in recent advancements in modern biotechnology? What are the initiatives taken by government towards genomic research in India?

Practice Questions

6. In light of the recent amendments to rules relating to regulation of GM crops in India, differentiate between R-DNA technology and gene editing techniques. Do you think regulatory discrimination between the two is necessary?

7. What is DNA/Gene patenting? What principles should guide the regulation of gene patenting in India in order to harness the potential of rising bioeconomy?

Status of Bioeconomy

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Relevance

- Sustainable agriculture for food and nutritional security
- Genomics, gene therapy for personalised and precision medicine
- Sustainable fuels for energy security
- Biodegradable materials for environmental sustainability (Replacement for plastics, Cellulolignosic biofuels, Xenobot)

- India BioEconomy Report 2022
  - Size: $80 billion 2021
  - No of start-ups: 5300
  - No of BT incubators 75
- Biotech Start-up Expo 2022

Practice Question on Bioeconomy

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What are factors responsible for growth of Bioeconomy in India?

Introduction

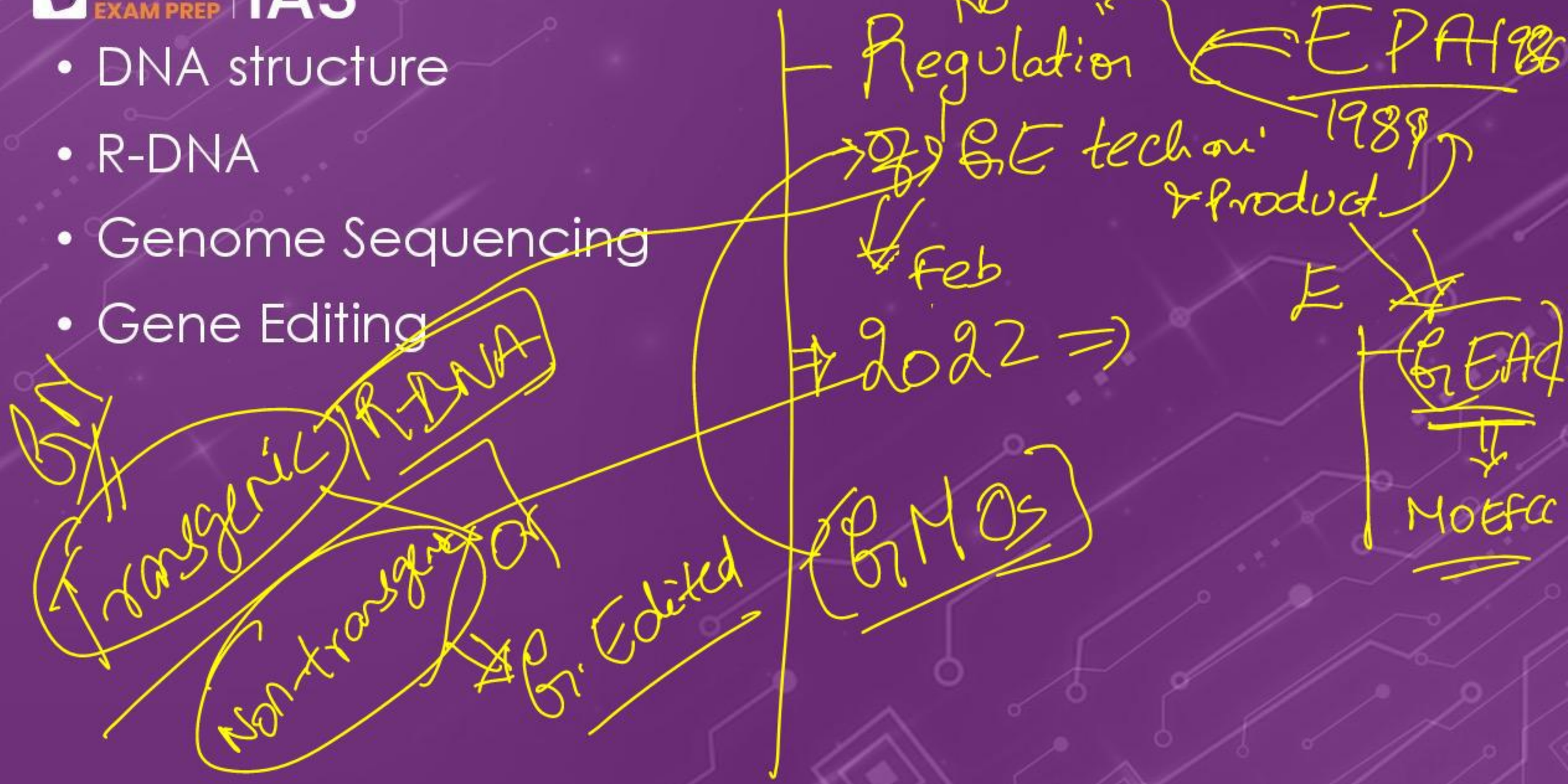
- Rapid growth of bioeconomy in recent times

Factors

1. Increased accessibility to technology
   - Cheaper
2. Institutional support
   - Research ecosystem (BIRAC, DBT)
   - Robust biosafety landscape (CBD, Cartagena Protocol)
3. Growing relevance
   - Food security (Golden Rice)
   - Health (Genomics, Gene therapy)
   - Environmental sustainability

Evolution of modern Biotechnology

- DNA structure
- R-DNA
- Genome Sequencing
- Gene Editing



Practice question: Recent techniques

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- R-DNA technology
  - facilitating gene transfer
  - process of cutting lacks precision
  - enzyme used for cutting the DNA is non-specific
- Genetic editing
  - Precisely as it involves reading the sequence
  - Enzymes are targeted: Site-directed Nuclease technique
  - Eg: under CRISPR-Cas9 technique use of guide RNA

In light of the recent amendments to rules relating to regulation of GM crops in India, differentiate between R-DNA technology and gene editing techniques. Do you think regulatory discrimination between the two is necessary?

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Advantages

- More precise
- Less time-consuming
- More accurate breeding

Concerns

- Regulation should be based on effect not on source of gene.

Application of Biotechnology

Agriculture - Plant and Animal

- Conventional
- Impact of R-DNA: GM Crops
- Impact of genomics: Rice Genomic Chip IndiGAU
- Impact Gene Editing

Health- Preventive, Diagnostics, Therapeutics

- Conventional
- Modern
- Impact of R-DNA: Insulin
- Impact of genomics: Gene Testing
- Impact of Gene Editing : CAR-T cell therapy

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Industry - Synthetic Biology, Bio-materials

- Conventional
- Modern
- Impact of R-DNA
- Impact of genomics
- Impact of Gene Editing

Eg: Pharma, Xenobots, Microbial fuel cells, Biofuels, lab-made meat

Environment

- Plastic pollution
- GE-bateria for nitrogen fixation

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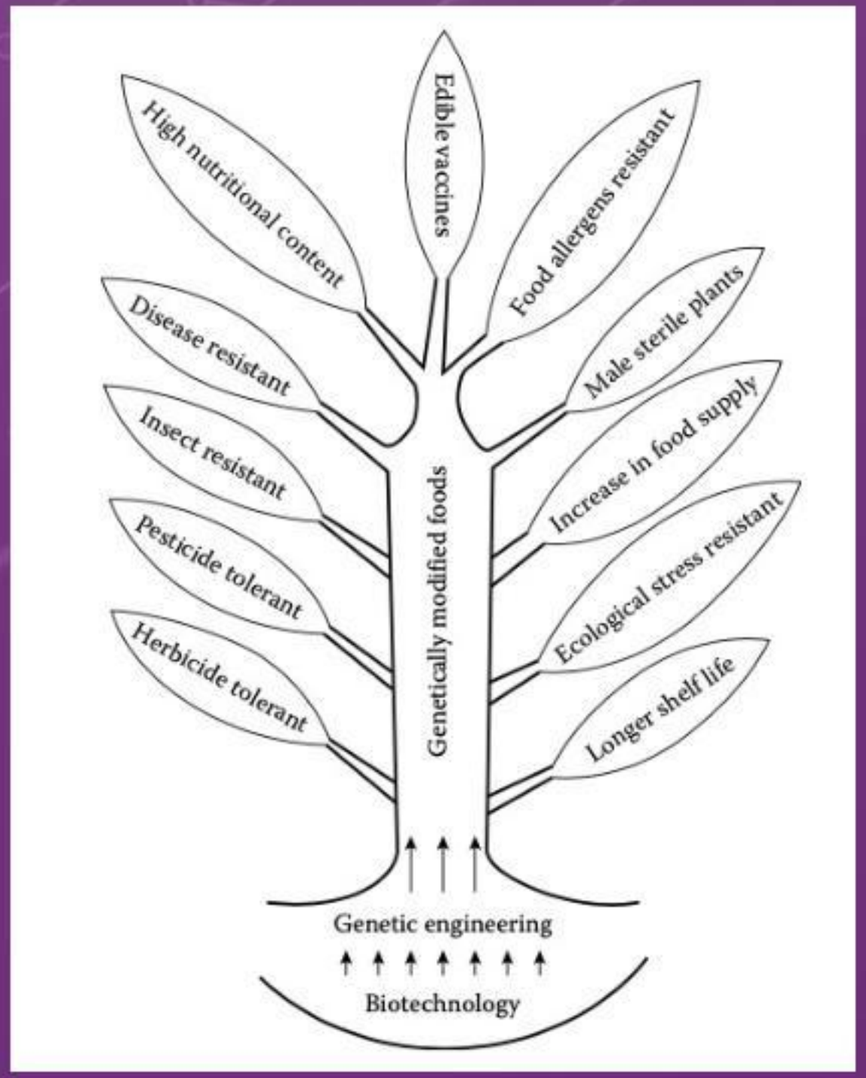
Green Biotechnology



Red Biotechnology

Conventional

Antibiotics, vaccines, antigens

Modern

Cell therapy

- Drug discovery and development
- Regenerative medicine

Gene therapy

3D-printed biomaterials

- Cornea, heart, liver, kidney etc.

Biosimilars

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White Biotechnology

Conventional

- Pharmaceuticals: antibiotics
- Food: Alcohol, curd, bread
- Waste treatment: oil spills
- Fuels
- Metallurgy

Modern

- Synthetic biology
- Biomaterials
- Food: Lab-grown meat
- Xenobots

Practice Question: Application of modern BT

2.What are the applications of modern biotechnology? What is the role of modern biotechnology in bringing about socio-economic development in the contemporary times?

Applications

- Agriculture
  - GM crops
- Healthcare
  - Gene therapy
- Industry
  - GE algae for biofuels, synthetic biology for modern materials
- Environment
  - Plastic pollution

Role

- Food Security
- Environment sustainability
- To make novel materials
- To make novel fuels

Practice question on Genomics

What is the role of Genomics in recent advancements in modern biotechnology? What are the initiatives taken by government towards genomic research in India?

Introduction

Database mapping genotype and phenotype

Potential in Agri, Health and Environment

Role

- Susceptibility to disease
- Genetic factors for behaviour
- How one reacts to treatments
- Faster breeding (Marker-assisted selection)
- Biosensors in pandemics: SARS COV-2
- reference genome
- Gateway to genetic modification
- Drug discovery
- Personalised treatments

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Initiatives

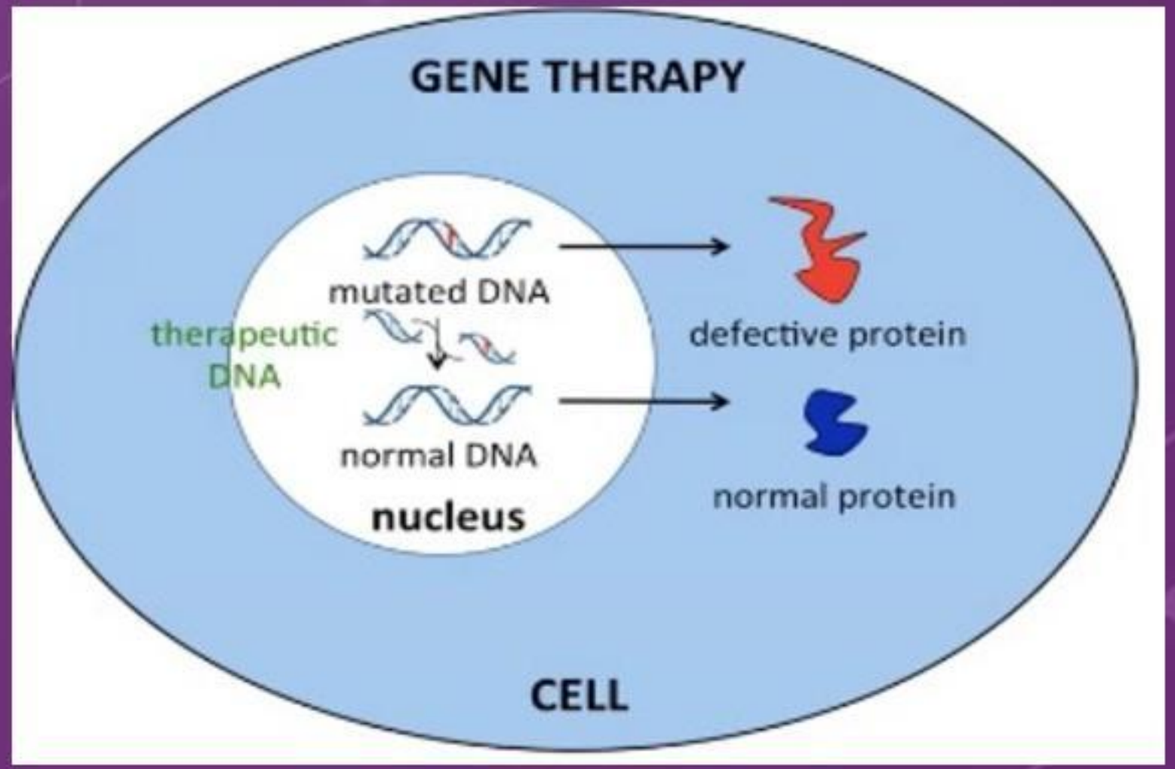
- Indigen Initiative
- Rice Genome Chips
- IndiGAU
- INSACOG: which coordinated

Gene Therapy

Q. Gene therapy is said to revolutionise medicine in the contemporary times. What is gene therapy? What are some of the important advances in the field of gene therapy in the recent times?

Gene Therapy: What?

- Correct a defective gene
- Alter gene expression
  - Translation



Types of Genetic Diseases

- Somatic diseases
- Inherited diseases