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TARGET MAINS 2022

CSE MAINS QUESTIONS DISCUSSION

SCIENCE AND TECHNOLOGY-2

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?

8. What is synthetic biology? What are the potential benefits of synthetic biology? What are the challenges for the growth of the discipline?

Application of Biotechnology

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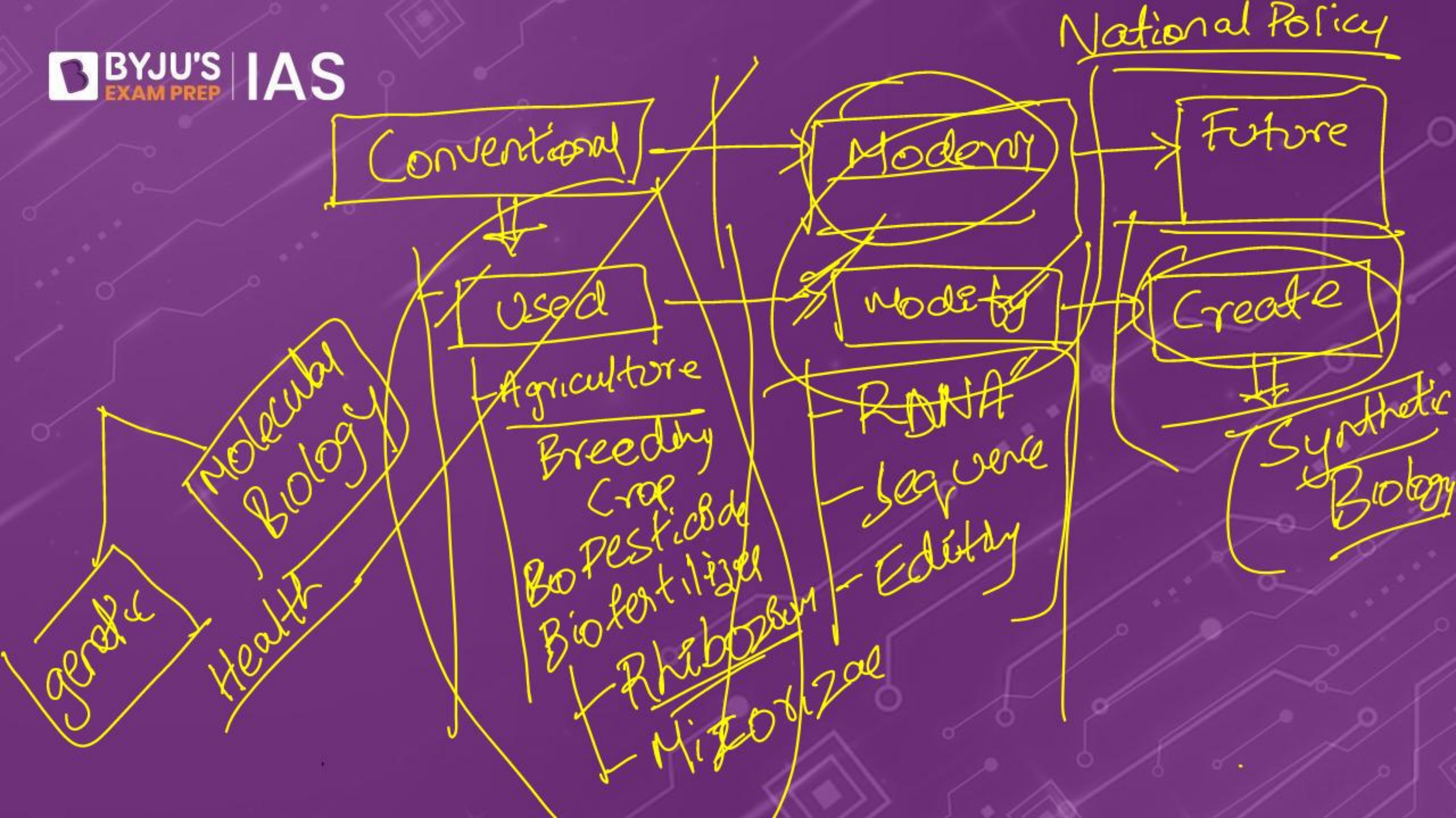
Agriculture - Plant and Animal

- 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, Erythropoietin, HPV, Hep B Vaccine
- Impact of genomics: Gene Testing
- Impact of Gene Editing : CAR-T cell therapy



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Industry - Synthetic Biology

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

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

Future

Environment

- Plastic pollution
- GE-bateria for nitrogen fixation

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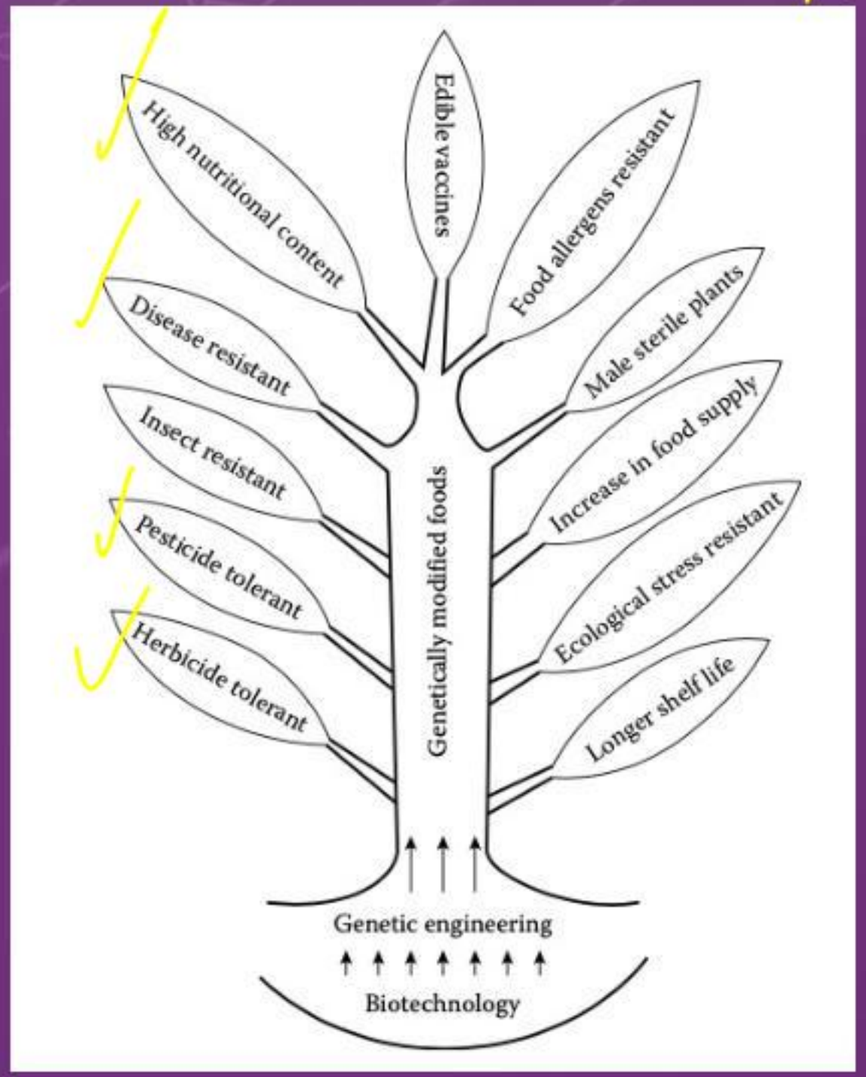
Green Biotechnology



Agriculture & Environment

Breeding

GM Crop

Golden Rice

Micro

Macro

Protato

Bt Cotton

Bollworm

Rice

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Red Biotechnology

Conventional

Antibiotics, vaccines, antigens

Modern

Cell therapy

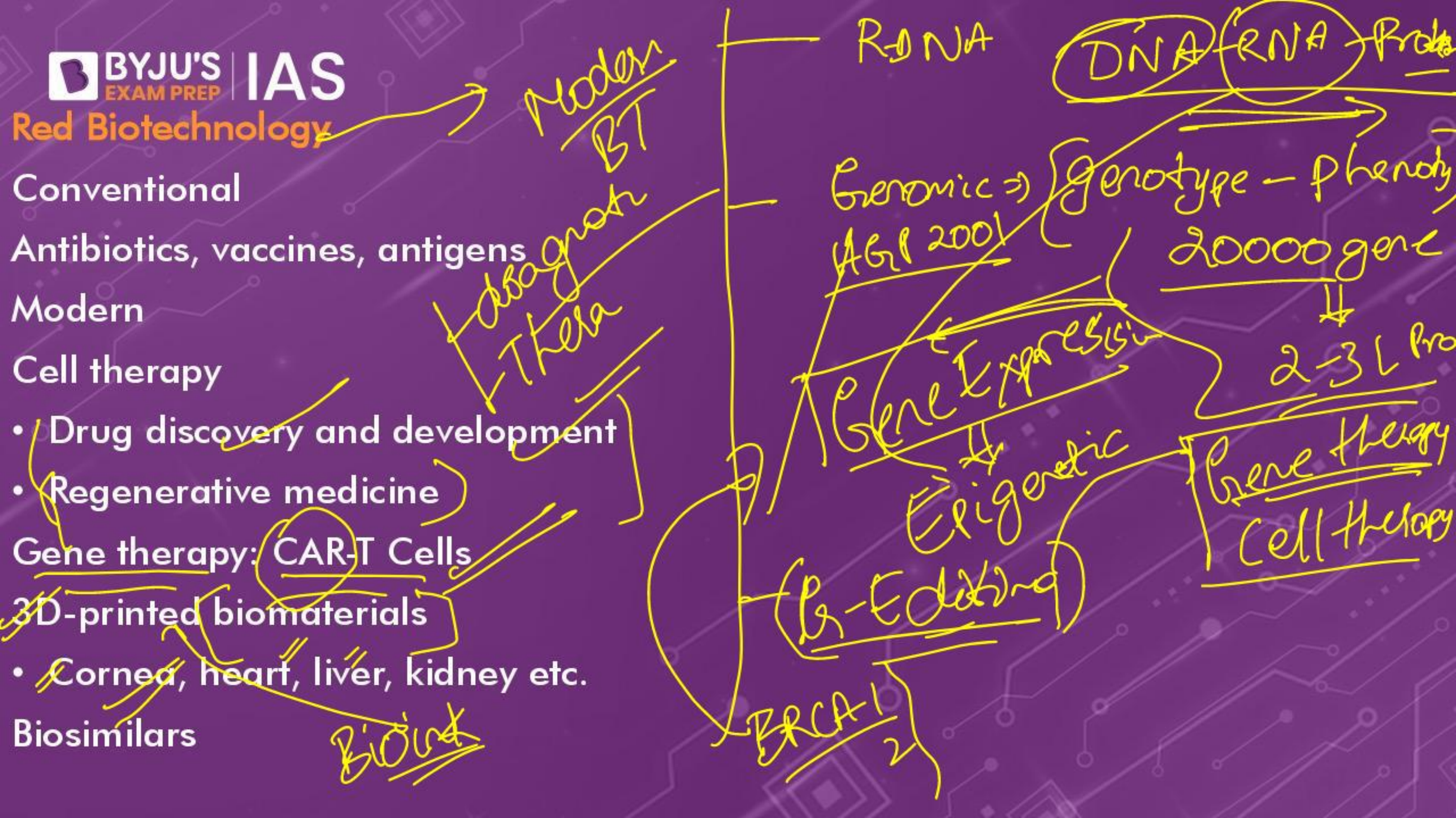
- Drug discovery and development
- Regenerative medicine

Gene therapy: CAR-T Cells

3D-printed biomaterials

- Cornea, heart, liver, kidney etc.

Biosimilars



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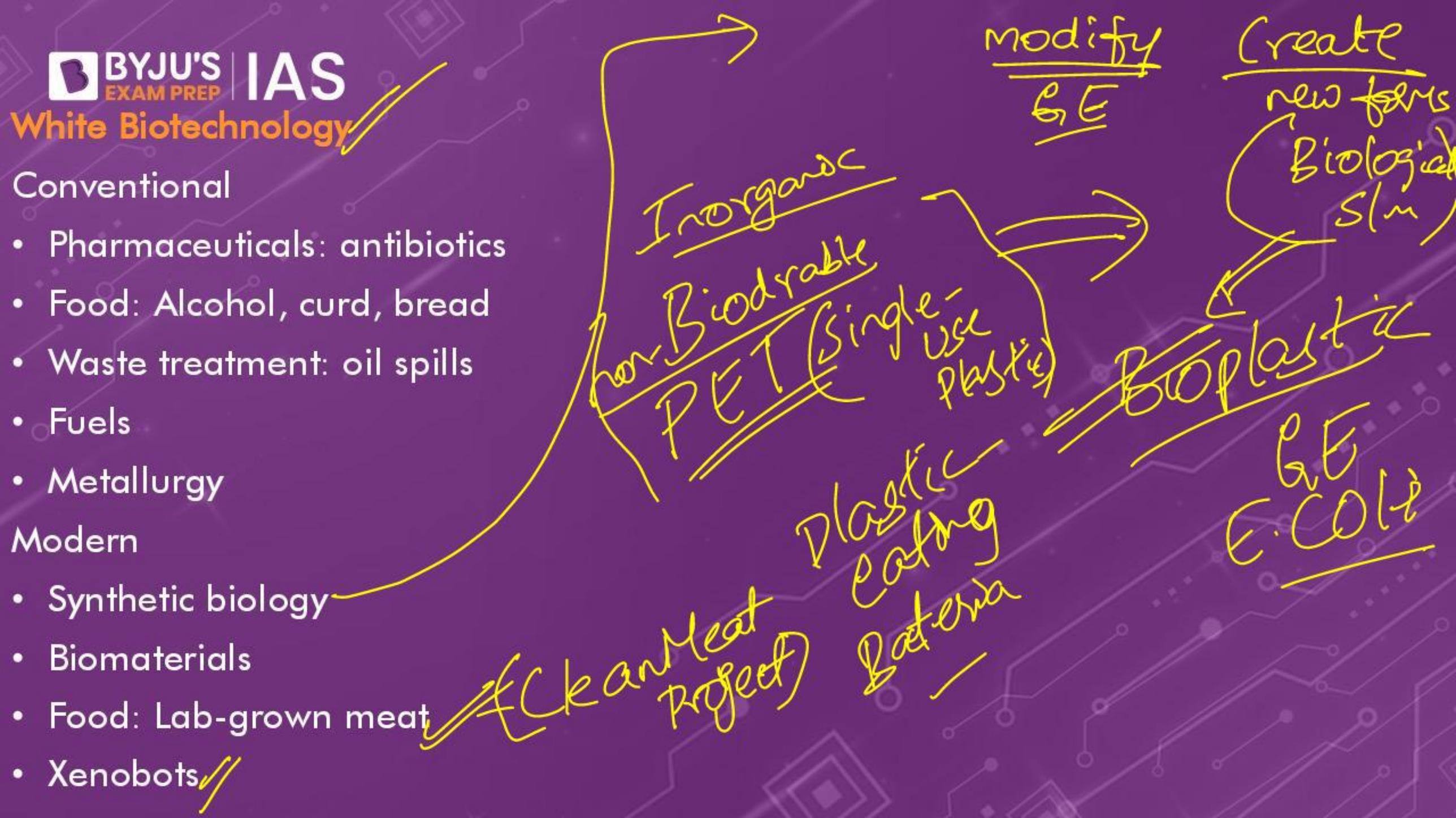
White Biotechnology

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

Synthetic Biology

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Q. What is synthetic biology? What are the potential benefits of synthetic biology? What are the challenges for the growth of the discipline?

Defn

- Construction of biological systems
- Bottoms-up approach

Approaches

Simple systems Eg: Artificial leaf

Combination of 2 or more biological systems Eg:

Engineering genes Eg:

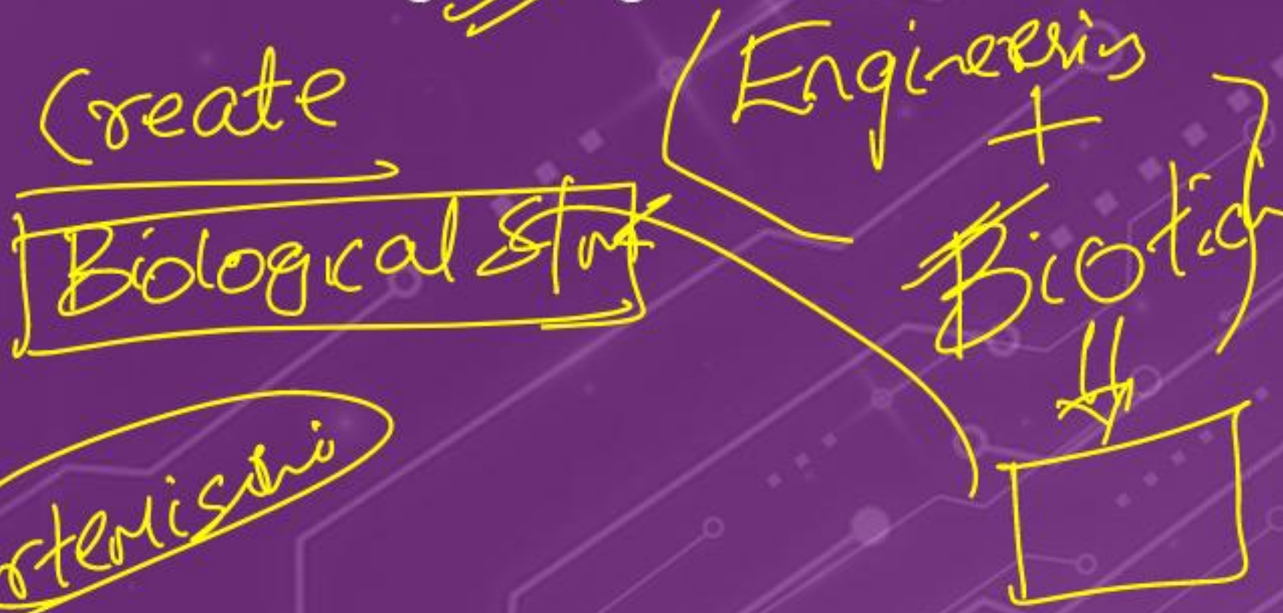
Creating Genes Eg: Antibiotic, Anti-malarial drug

Potential Applications

Novel materials Eg: bioplastics, Bio-PET

Novel drugs

Novel food Eg: Lab-grown meat



Synthetic Biology

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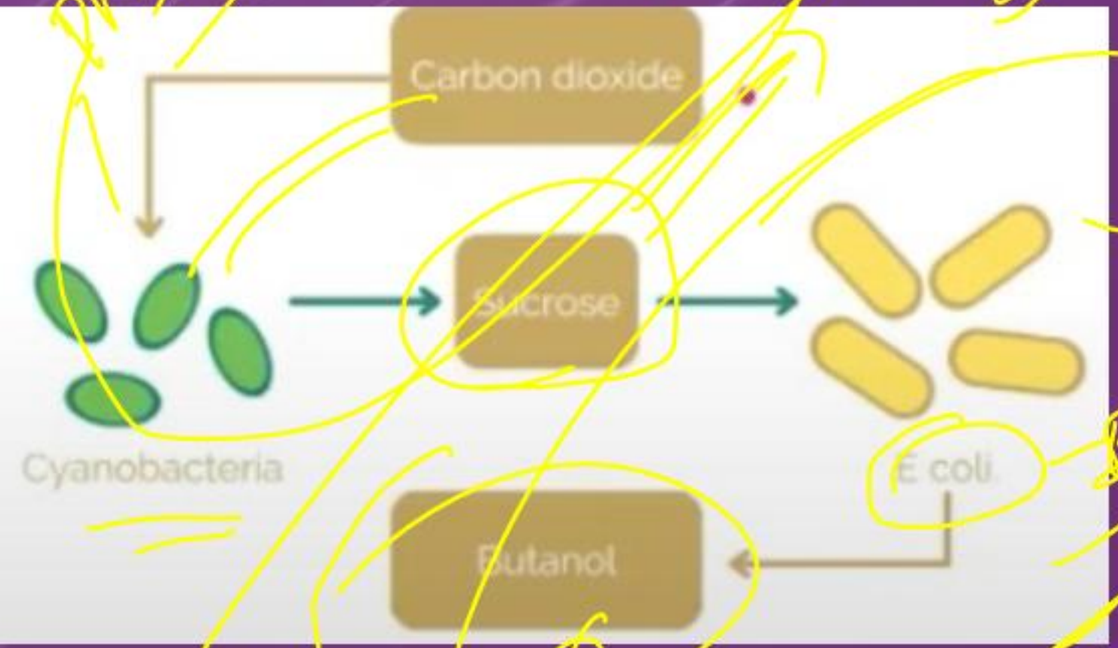
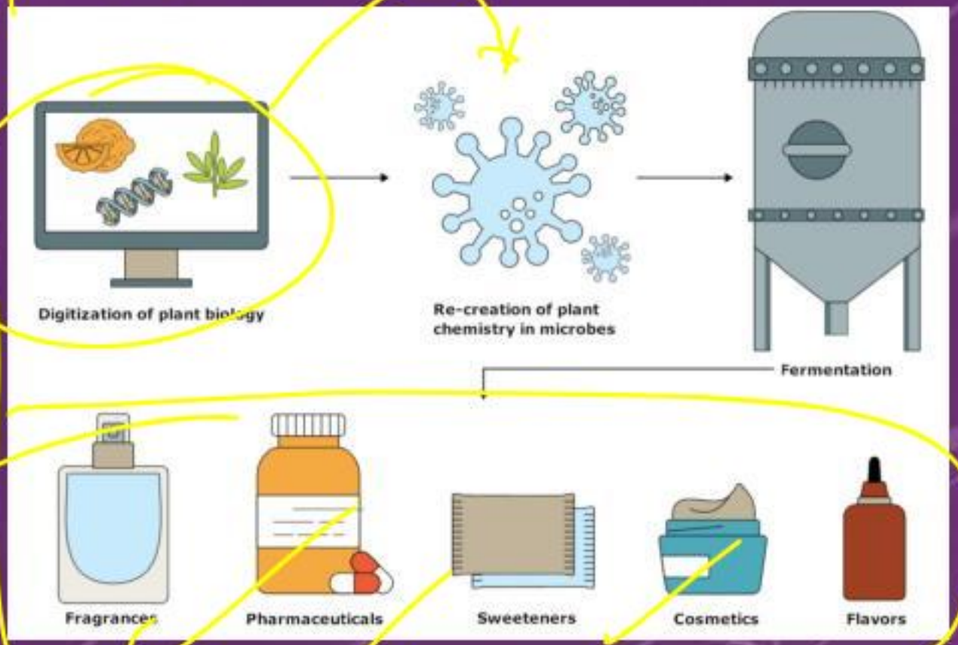
Combination of biological systems



Engineering genes



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ZME Science

A novel synthetic antibiotic shows promise in destroying even drug-resistant bacteria

A novel synthetic antibiotic shows promise in destroying even drug-resistant bacteria. New, efficient antibiotics are sorely needed in the...

1 week ago

News-Medical.net

New method could lead to more efficient production of next-generation antibiotics

We had been analyzing fatty acid synthesis for several years when we ... be used for directed biosynthesis of these modified antibiotics,...

11 hours ago

Interesting Engineering

A novel synthetic antibiotic can kill even drug-resistant bacteria

Scientists from Rockefeller University have synthesized a novel antibiotic with the help of computer models of bacterial gene products. It turns...

1 week ago

Modify

World's first living organism with fully redesigned DNA created

Enzyme

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

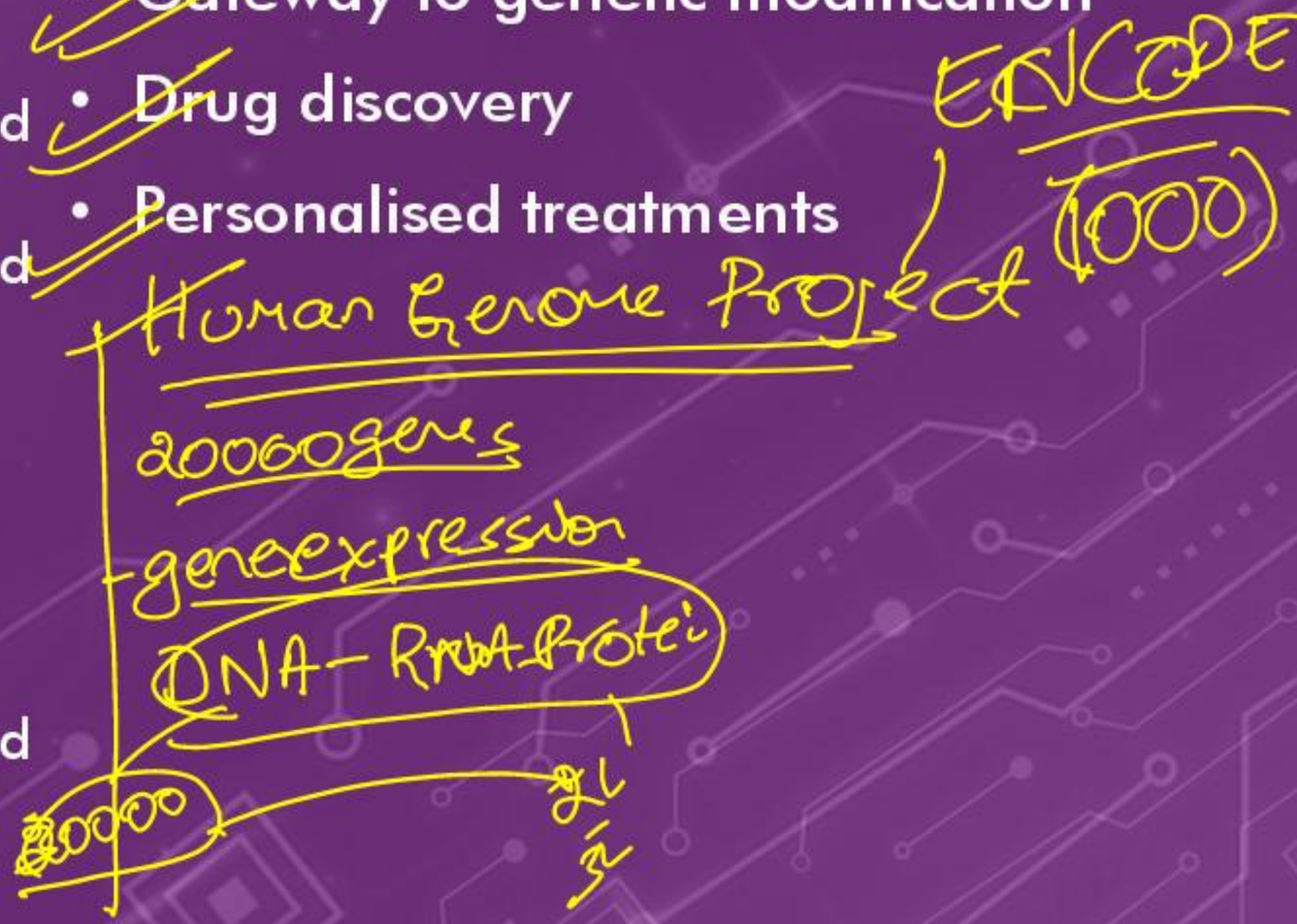
Database mapping genotype and phenotype

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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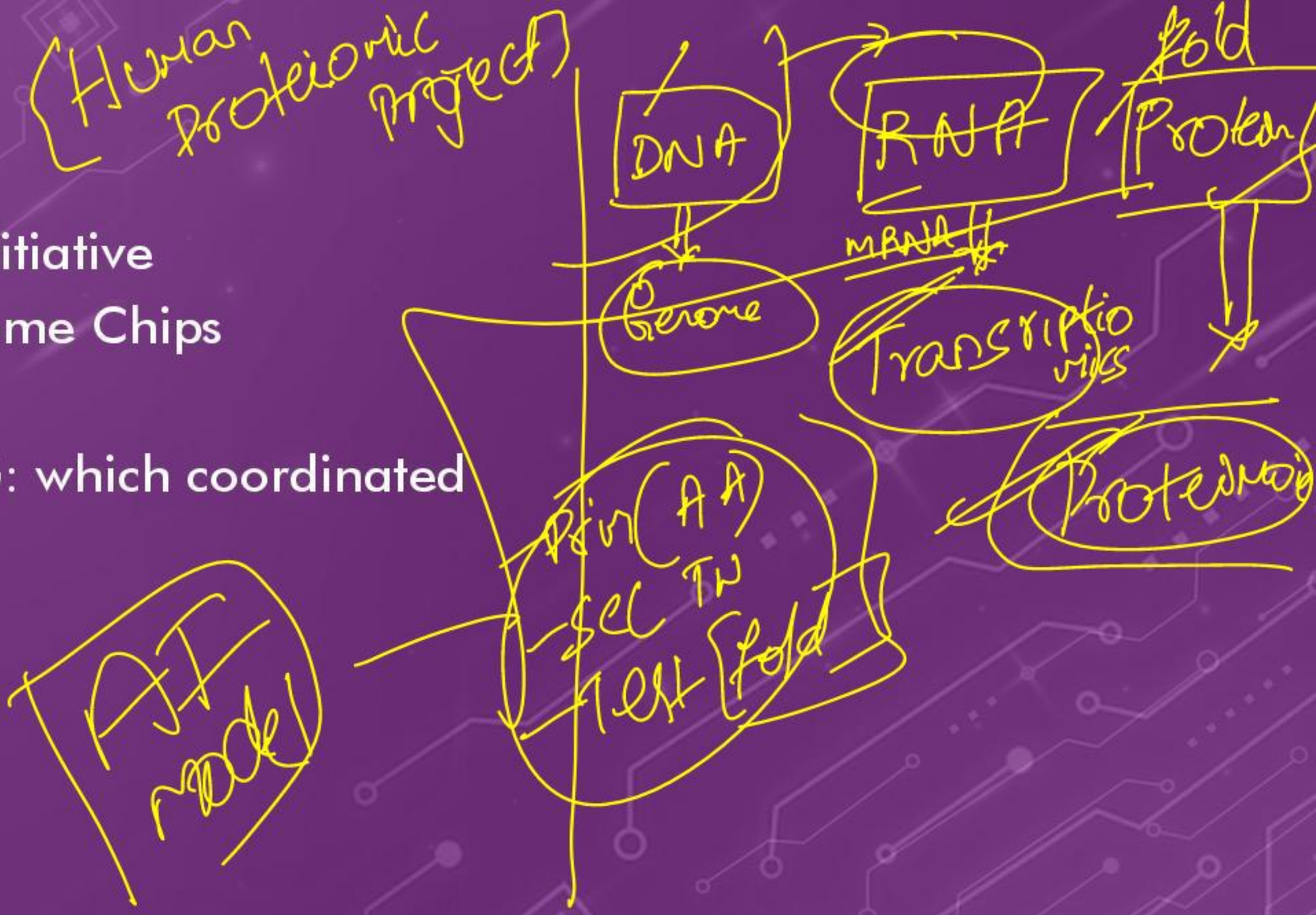
Initiatives

- 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?

2019 (National Guidelines for Gene therapy)

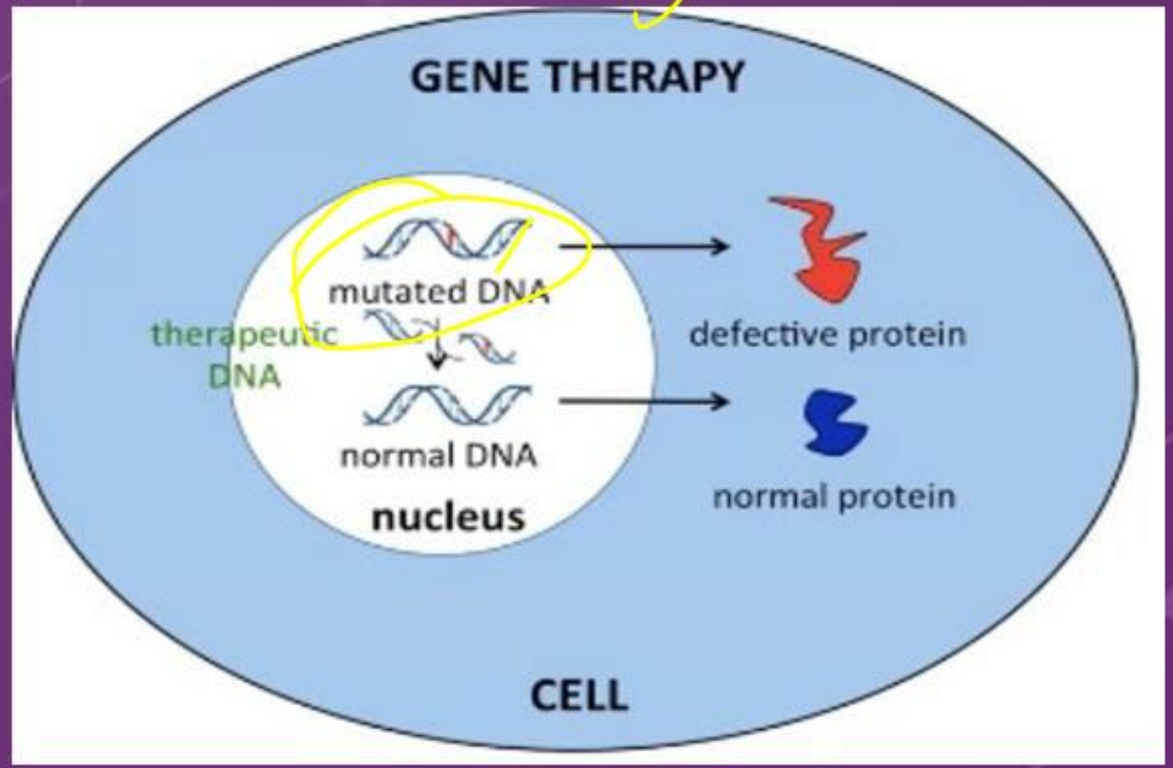
2017 ⇒ Glybera (USA) #Aerophobia

Gene Therapy: What?

- Correct a defective gene
- Alter gene expression
  - Translation
  - Transcription

Types of Genetic Diseases

- Somatic diseases
- Inherited diseases



Gene Therapy: Types

Types

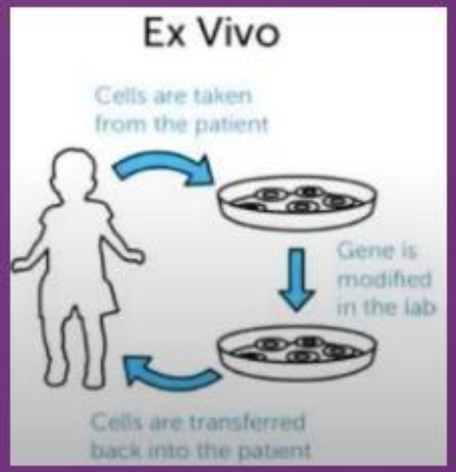
- Gene replacement
- Gene silencing
- Gene editing
- Gene addition/ augmentation (CAR-T cell therapy)

Advantages and Challenges

- Monogenic diseases
- Specific cells
- Long-lasting
- Delivery mechanism
- Disruption normal genes
- Immune response

Gene Delivery: Vectors

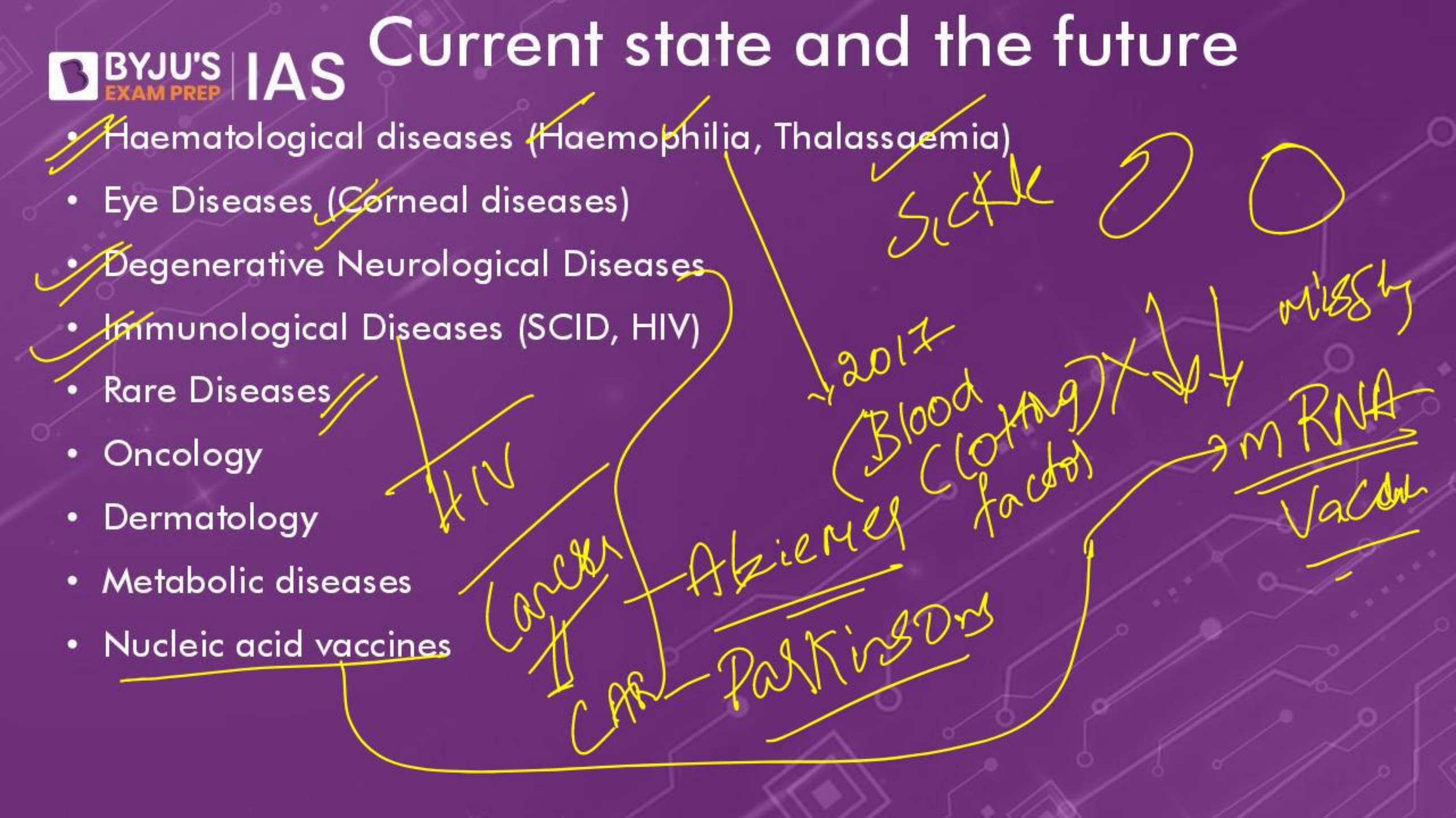
- Where?
  - In-vivo
  - Ex-vivo



- How?
  - Viral
    - Retrovirus
    - Adenovirus
    - AAV
  - Non-viral
    - Naked DNA
    - Platforms

Current state and the future

- Haematological diseases (Haemophilia, Thalassaemia)
- Eye Diseases (Corneal diseases)
- Degenerative Neurological Diseases
- Immunological Diseases (SCID, HIV)
- Rare Diseases
- Oncology
- Dermatology
- Metabolic diseases
- Nucleic acid vaccines

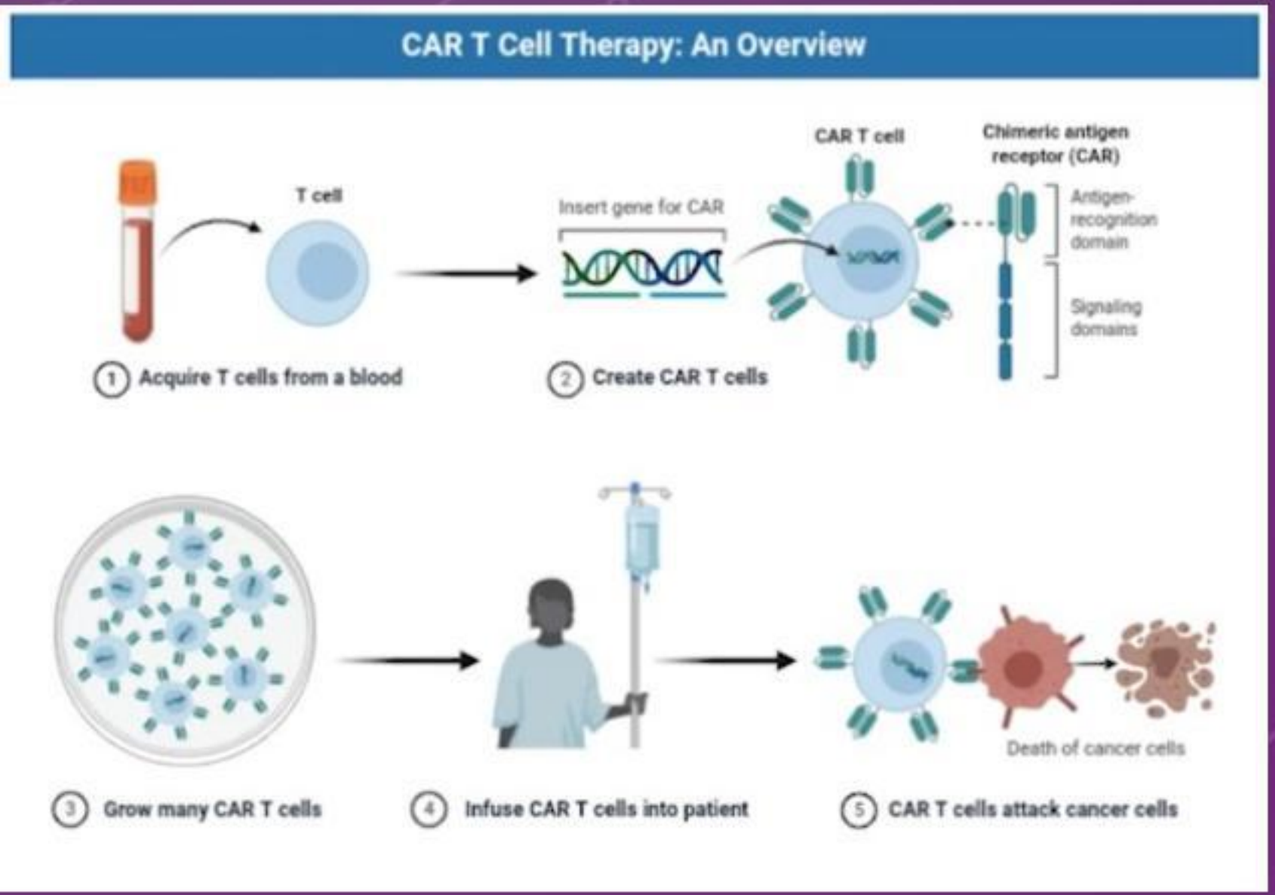


CAR-T cell therapy

Department of Biotechnology supported First CAR-T cell therapy conducted at ACTREC, Tata Hospital in Mumbai

DBT/BIRAC-NBM Supported Phase I/II Clinical Trials

Posted On: 08 JUN 2021 11:12AM by PIB Delhi



BYJU'S EXAM PREP | IAS Regulation of Genome Engineering Technologies

Primary Law

"Rules for the manufacture, use, import, export & storage of hazardous microorganisms, genetically engineered organisms or cells, 1989" under the Environment (Protection) Act, 1986.

Institutional framework

- Institutional Biosafety Committee
- Review Committee on Genetic Manipulation
- GEAC
- Monitoring is done by Committees at District, State and Central level.

Other legislations

- Plant Quarantine Order, 2003
- Biological Diversity Act, 2002
- Food Safety and Standards Act, 2006
- ICMR guideline related to biosafety of GM food in 2008.

Gene Patenting Landscape in India

- Section 3(c)
- Section 3(j)
- Manual of Patent Practice 2005 (BT inventions)
  - Novel
  - Significant human intervention
  - Industrial application
- SC decision in Monsanto Case 2019