



Principles of Biotechnology

The intersection of natural science and molecular engineering.

The EFB Definition

The integration of natural science and organisms, cells, parts thereof, and molecular analogues for products and services.

The Two Core Techniques of Modern Biotechnology



1. Genetic Engineering

- Focus: The Micro-Level Toolkit.
- Function: Techniques to alter the chemistry of genetic material (DNA and RNA).
- Outcome: Introducing these into host organisms to intentionally change the phenotype of the host.



2. Bioprocess Engineering

- Focus: The Macro-Level Scale-Up.
- Function: Maintenance of a sterile (microbial contamination-free) ambience in chemical engineering processes.
- Outcome: Enabling the growth of only the desired microbe/eukaryotic cell in large quantities for manufacturing.

Genetic Engineering: The Molecular Mechanism

The Problem with Traditional Hybridization

Multiplies undesirable genes alongside desired ones.

The GE Solution

Isolates and introduces only the desired set of genes.



Cut

Restriction Endonucleases ('Molecular Scissors') isolate the specific gene of interest.



Combine

DNA Ligase pastes the alien DNA into a Vector (e.g., a Plasmid) to create Recombinant DNA.



Transfer & Multiply

The vector delivers the DNA into a Host Organism. The alien DNA must link to the host's Origin of Replication to multiply and be inherited.



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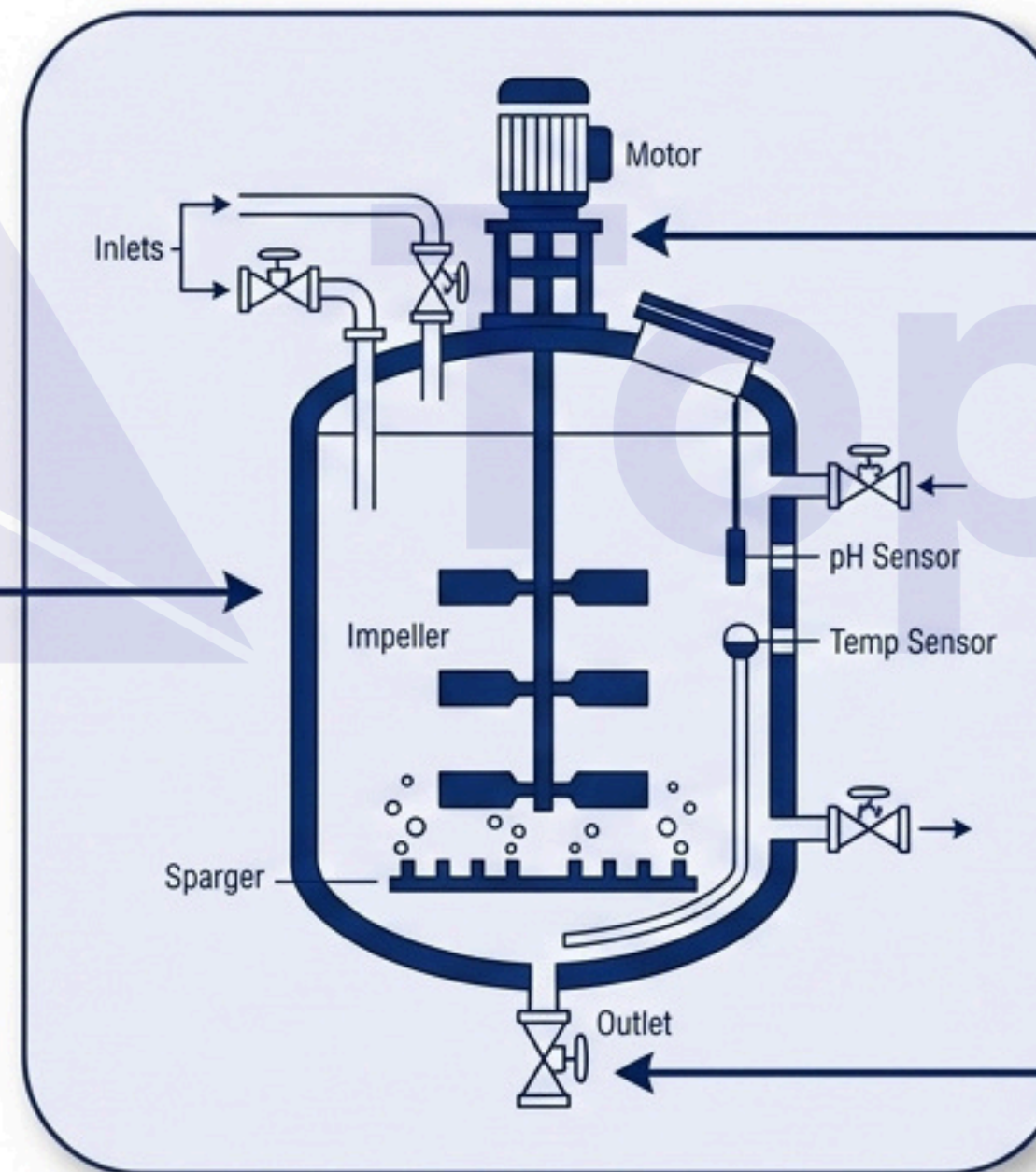


Bioprocess Engineering: Industrial Scale-Up

Small volume cultures cannot yield appreciable quantities. Bioreactors (100–1000 litres) act as vessels to biologically convert raw materials into specific products.

Optimal Conditions:

Stirred-tank reactors maintain exact temperature, pH, substrate, salts, vitamins, and oxygen availability.



Sterile Ambience:

Strict contamination-free environment ensures only the desired transformed cell grows.

Downstream Processing:

Post-biosynthesis steps including rigorous separation, purification, and clinical quality control formulation.

The Tangible Products of Biotechnology



Antibiotics

Large-scale bioprocessing of naturally occurring or genetically enhanced fungi and bacteria to produce life-saving antibacterial compounds in massive quantities.



Vaccines

Synthesizing specific DNA vaccines or producing recombinant surface proteins safely without utilizing disease-causing, live pathogens.



Industrial Enzymes

Harvesting purified enzymes (like lipases or proteases) engineered for optimal performance in detergents, food processing, and pharmaceuticals.

NEET Key Takeaways: High-Yield Matches

Concept / Tool	Biological Function & Exam Definition
Restriction Enzymes	“Molecular Scissors” used to cut DNA at specific locations.
DNA Ligase	The enzyme used to paste/link alien DNA with plasmid DNA.
Plasmid Vector	Delivery vehicle used to transfer an alien piece of DNA into the host (e.g., mosquito transferring malaria).
Origin of Replication	Specific DNA sequence responsible for initiating replication; alien DNA must link here to multiply.
Downstream Processing	The final separation, purification, and formulation stages before marketing.
EFB	European Federation of Biotechnology.



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