CBSE Class 12 Biology Notes Chapter 11: These notes are important for students preparing for their CBSE Class 12 board exams in Biology. Chapter 11 Biotechnology: Principles and Processes, focuses on the fundamental techniques and concepts of biotechnology, such as recombinant DNA technology, gene cloning and the role of enzymes in genetic manipulation. The notes simplify complex biological processes making them easier for students to grasp.

By studying this chapter students can gain a deeper understanding of how biotechnology is applied in various fields like medicine, agriculture and industry.

CBSE Class 12 Biology Notes Chapter 11 Biotechnology: Principles and Processes Overview

These notes for CBSE Class 12 Biology Chapter 11 Biotechnology: Principles and Processes are prepared by subject experts of Physics Wallah. They provide a clear and concise overview of important concepts such as recombinant DNA technology, gene cloning, and the role of restriction enzymes and vectors in genetic engineering.

By breaking down complex topics into simpler explanations, these notes help students easily understand the fundamental principles of biotechnology. These expert-created notes ensure thorough preparation making it easier for students to secure good marks in their board exams.

CBSE Class 12 Biology Notes Chapter 11 Biotechnology: Principles and Processes PDF

CBSE Class 12 Biology Notes for Chapter 11 Biotechnology: Principles and Processes provide a detailed understanding of important biotechnology concepts.

Whether you're revising for exams or building a strong foundation in biology these notes are an invaluable resource. The PDF link for these notes is available below for easy access and download.

CBSE Class 12 Biology Notes Chapter 11 Biotechnology: Principles and Processes PDF

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Here we have provided CBSE Class 12 Biology Notes Chapter 11 Biotechnology: Principles and Processes-

Principles of Biotechnology

Modern biotechnology is based on two key principles:

1. **Genetic Engineering**: This involves modifying the DNA of a target organism to change its phenotype. It allows for the manipulation of genetic material to produce desired traits in the organism.
2. **Bioprocess Engineering**: This principle focuses on maintaining sterile conditions to cultivate large quantities of microorganisms and eukaryotic cells. These are essential for producing biotechnological products such as antibiotics, enzymes, and vaccines.

The techniques of genetic engineering typically follow these steps:

- Isolating the desired DNA fragment from the donor organism.
- Inserting this DNA into a vector.
- Transferring the vector into a suitable host organism.
- Cloning the recombinant DNA within the host to replicate and express the desired trait.

What Is Recombinant DNA Technology?

Recombinant DNA technology, also known as genetic engineering, is the process of combining DNA molecules from two different organisms to create recombinant DNA. This technique allows scientists to introduce new genetic material into an organism to produce desired traits or products.

The steps involved in recombinant DNA technology are:

1. **Isolation of DNA**: The DNA of interest is extracted from the donor organism.
2. **DNA Fragmentation**: Restriction endonucleases are used to cut the DNA into fragments.
3. **Ligation**: The desired DNA fragment is inserted into a vector (carrier DNA).
4. **Transfer**: The recombinant DNA is introduced into a suitable host organism.
5. **Culture**: The host cells containing recombinant DNA are grown in a nutrient medium.
6. **Extraction**: The desired product, such as a protein or enzyme, is extracted from the cultured cells.

DNA Cloning

DNA cloning is the process of producing multiple identical copies of a specific DNA fragment. This is an essential technique in genetic engineering and biotechnology. To achieve DNA cloning, cloning vectors are used, and these vectors must possess the following properties:

1. **Small Size but Large DNA Capacity**: The vector should be small for easier manipulation but must carry a large DNA insert.

2. **Origin of Replication**: It should have an origin of replication to enable autonomous replication within the host organism.
3. **Restriction Site**: The vector must have a restriction site where the DNA fragment can be inserted.
4. **Selectable Marker**: It should include a marker gene to help identify and select recombinant organisms.
5. **Multiple Cloning Sites**: The vector should have several sites where different DNA fragments can be inserted for versatility in cloning experiments.

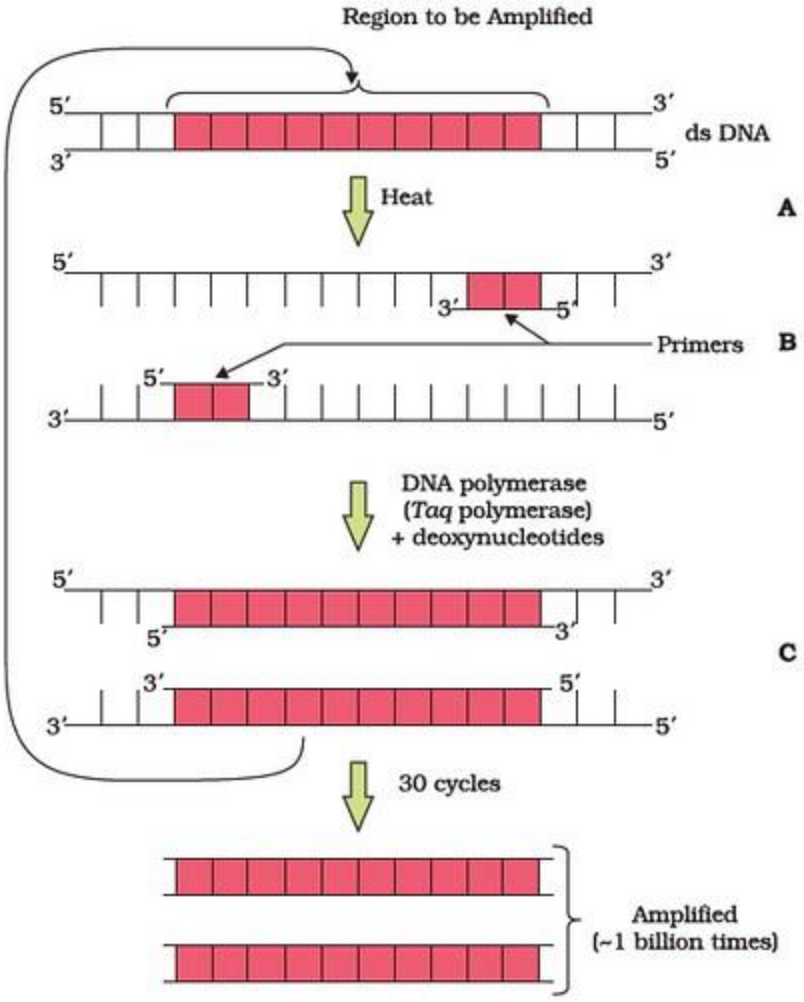
What Is Bioprocess Engineering?

Bioprocess engineering involves the cultivation and multiplication of cells in bioreactors to produce large quantities of biological products. This process results in a high yield of the desired proteins or other biological materials. Once produced, the products undergo **downstream processing**, which includes purification and quality control checks. Before being released or further developed, the products are tested to ensure safety and effectiveness. Bioprocess engineering is widely used in the production of **antibiotics, vaccines and other therapeutic medicines** playing a important role in the biotechnology industry.

Cloning Vector

Cloning vectors are essential tools in recombinant DNA technology, allowing for the insertion and replication of foreign DNA in a host organism. **Plasmids** and **bacteriophages** are commonly used vectors. They have the ability to replicate independently within bacterial cells making them ideal for cloning purposes. Bacteriophages, due to their high copy numbers, ensure numerous copies of their genome within bacterial cells.

Key features of cloning vectors include:



1. **Origin of Replication (ori)**: A sequence from which replication begins. When DNA is linked to this sequence, it can replicate within host cells, controlling the copy number of the linked DNA.
2. **Selectable Marker**: This helps identify and select transformed cells by encoding resistance to antibiotics such as ampicillin or tetracycline. These markers are used to differentiate between non-transformants and transformants, ensuring only cells with recombinant DNA survive.
3. **Cloning Sites**: Single recognition sites for restriction enzymes are required for the insertion of foreign DNA. Multiple restriction sites could generate fragments that complicate the cloning process. The insertion of foreign DNA typically disrupts one of the antibiotic resistance genes, helping identify successful recombinants.
4. **Insertional Inactivation**: This technique is used to identify recombinant plasmids. When a foreign DNA fragment is inserted, it disrupts the coding sequence of a gene, such as the **lac Z gene** in the **Blue-White selection** process. Recombinant colonies appear white due to the inactivation of the lac Z gene, while non-recombinants appear blue.
5. **Vectors for Plants and Animals**: In plants, the bacterium *Agrobacterium tumefaciens* delivers T-DNA, transforming plant cells and modifying them into tumor cells. The **Ti**

plasmid of *Agrobacterium* has been modified to serve as a cloning vector, eliminating its pathogenic properties. In animals, retroviruses are used as vectors to insert recombinant DNA and transform cells, such as inducing cancerous transformations.

Transformation of Host Cells

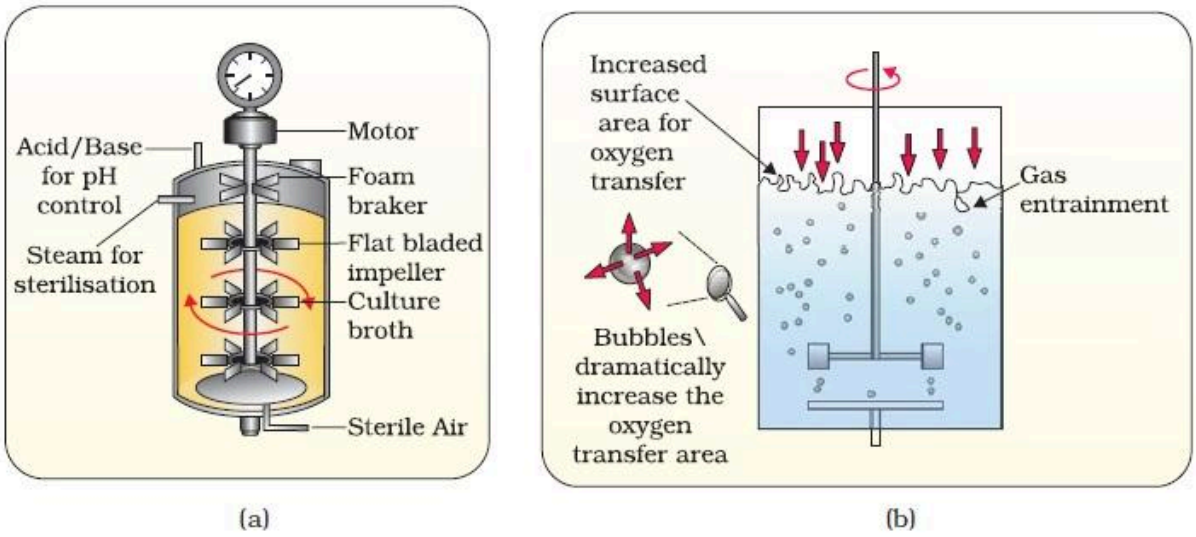


Figure 11.7 (a) Simple stirred-tank bioreactor; (b) Sparged stirred-tank bioreactor through which sterile air bubbles are sparged

Transformation of recombinant DNA into host cells can be achieved using various methods, including:

1. **Chemical Treatment**: Using divalent calcium ions, bacterial cell walls become more permeable to take up recombinant plasmids.
2. **Heat Shock**: Incubating the host cells on ice, followed by a brief exposure to 42°C, facilitates the uptake of recombinant DNA.
3. **Microinjection**: In this method, recombinant DNA is directly injected into the host cell's nucleus using a glass micropipette.
4. **Biolistics/Gene Gun Method**: Primarily used for plant cells, microscopic particles of gold or tungsten coated with DNA are bombarded into the host cells.
5. **Disarmed Pathogens**: *Agrobacterium tumefaciens*, when allowed to infect cells, transfers recombinant DNA into the host.

Processes of Recombinant DNA Technology

Recombinant DNA technology involves several key steps:

1. **Isolation of DNA**: The genetic material is isolated from cells using enzymes such as lysozyme (for bacteria), cellulase (for plant cells), and chitinase (for fungi).

2. **Fragmentation**: Restriction endonucleases cut the DNA at specific sites, and agarose gel electrophoresis is used to monitor the progress.
3. **Amplification of DNA (PCR)**: The polymerase chain reaction (PCR) technique is used to generate multiple copies of the gene of interest. PCR involves repeated cycles of denaturation, primer annealing, and extension, utilizing thermostable DNA polymerase from *Thermus aquaticus*.
4. **Insertion of Recombinant DNA**: The host cells are made competent to take up the recombinant DNA, often through chemical treatments or heat shock.
5. **Gene Expression**: The foreign DNA multiplies in the host cell and expresses the desired protein. Optimal conditions are maintained in **bioreactors** to ensure the production of the recombinant protein.
6. **Downstream Processing**: Once the desired product is obtained, it undergoes purification and quality control before being prepared for the market. In the case of drugs, clinical trials are conducted before public release.

Benefits of CBSE Class 12 Biology Notes Chapter 11

- **Understanding Core Concepts**: Grasping the fundamental principles of biotechnology helps in understanding how biological systems can be manipulated for various applications essential for exam questions on theory and applications.
- **Application of Knowledge**: Knowledge of genetic engineering and bioprocess engineering allows students to relate theoretical concepts to real-world scenarios making it easier to answer application-based questions.
- **Enhanced Problem-Solving Skills**: Studying the techniques and processes of recombinant DNA technology fosters analytical thinking and problem-solving skills crucial for tackling complex exam problems.
- **Current Relevance**: Biotechnology is a rapidly evolving field with significant implications in medicine, agriculture and industry.
- **Preparation for Future Studies**: A solid foundation in biotechnology prepares students for advanced studies or careers in biomedical research, genetic engineering and pharmaceutical development, setting the stage for future academic and professional success.
- **Boosting Confidence**: A thorough grasp of the subject matter boosts confidence in answering exam questions leading to better performance and reduced anxiety.