

Biotechnology and Beyond: An Introduction to the “New” Life Sciences Industry

Course Outline

Day 1- Morning

Part 1 – INTRODUCTION

1.0 Biotechnology and the Life Sciences Industry

- 1.1 Evolution of the Life Sciences Industry
- 1.2 The Component Technologies
- 1.3 The Applications
- 1.4 The Business
- 1.5 The Rules

2.0 Fundamental Biological Principles

- 2.1 Cells: The Basic Unit of Life
 - 2.1.1 Structure of the Cell
 - 2.1.2 Cell Division
 - 2.1.3 Properties of Cells
- 2.2 Biomolecules: The Building Blocks of Life
 - 2.2.1 Proteins
 - 2.2.2 Carbohydrates
 - 2.2.3 Lipids
 - 2.2.4 Nucleic Acids
 - 2.2.5 Summary
- 2.3 DNA and the Genetic Code
 - 2.3.1 DNA Structure
 - 2.3.2 DNA Replication
 - 2.3.3 Gene Expression: Transcription and Translation
 - 2.3.4 Gene Regulation
- 2.4 Extrachromosomal DNA
 - 2.4.1 Plasmids
 - 2.4.2 Bacteriophage and Viruses
 - 2.4.3 Artificial Chromosomes

Part 2 – THE COMPONENT TECHNOLOGIES

3.0 Genetic Engineering Technology

- 3.1 Selective Breeding
- 3.2 Selective Mutation
- 3.3 Recombinant DNA Technology
 - 3.3.1 Restriction Enzymes
 - 3.3.2 Analysis of DNA
 - 3.3.3 DNA Cloning
 - 3.3.4 DNA Sequencing
 - 3.3.5 Nucleic Acid Hybridization
 - 3.3.6 Protein Engineering

LUNCH

Day 1 – Afternoon

4.0 Cell Culture Technology

- 4.1 Plant Cell Culture
 - 4.1.1 Micropropagation
 - 4.1.2 Callus
 - 4.1.3 Suspension Culture
 - 4.1.4 Somatic Embryogenesis
- 4.2 Animal Cell Culture
 - 4.2.1 Growth Conditions for Animal Cell Culture
 - 4.2.2 Cell Lines
 - 4.2.3 Primary Cultures
 - 4.2.4 Suspension Cultures
 - 4.2.5 Stem Cells

5.0 Cell Fusion Technology

- 5.1 Cell Fusion
- 5.2 Gene Transfer by Cell Fusion
 - 5.2.1 Protoplast fusion
 - 5.2.2 Liposomes
- 5.3 The Monoclonal Antibody
 - 5.3.1 Immunity
 - 5.3.2 Monoclonal vs Polyclonal Antibodies
 - 5.3.3 Making Monoclonal Antibodies
 - 5.3.4 Applications and Limitations

6.0 Bio-Process and Bio-production Technologies

- 6.1 Large scale propagation of cells
 - 6.1.1 Bioreactor/fermentation technology
 - 6.1.2 Downstream Processing
- 6.2 Biomass as a Product
 - 6.2.1 Food
 - 6.2.2 Bioproducts
 - 6.2.2.1 Energy
 - 6.2.2.2 Substitution for Petroleum Products
 - 6.2.2.3 Wastes as Biomaterials
 - 6.2.2.4 Recombinant Production Systems
- 6.3 Bio-Processing
 - 6.3.1 Bioconversion
 - 6.3.2 Biodegradation

7.0 Enzyme Technology

- 7.1 Enzymatic Bioconversion
- 7.2 Enzymes in Diagnostics
- 7.3 Enzymes as Products
 - 7.3.1 Enzyme Replacement Therapy
 - 7.3.2 Cosmetics

8.0 Immobilization Technology

- 8.1 Immobilization of Cells and Biomolecules
- 8.2 Continuous Flow Bio-processing
- 8.3 Microarray Technology
- 8.4 Microfluidics and Laboratory Miniaturization

9.0 Bioinformatics Technology and the “Omics” Revolution

- 9.1 What is Bioinformatics?
- 9.2 Genomics
 - 9.2.1 Structural Genomics
 - 9.2.2 Functional Genomics
- 9.3 Transcriptomics
- 9.4 Proteomics
- 9.5 Metabolomics
- 9.6 Structural Biology
- 9.7 Pharmacogenomics

Part3 – APPLICATIONS OF BIOTECHNOLOGY

10.0 Applications in Food

- 10.1 Bioprocessing of Foods
 - 10.1.1 Whole Cells
 - 10.1.2 Enzymes
- 10.2 Value-added Foods
- 10.3 Food Ingredients
- 10.4 Functional Foods

11.0 Applications in Marine Sciences

- 11.1 Bioprospecting of Marine Environments
- 11.2 Aquaculture
- 11.3 Genetic Enhancement of Fish

Day 2- Morning

12.0 Applications in Agriculture

- 12.1 Plant Agriculture
 - 12.1.1 Genetic Engineering in Plants
 - 12.1.1.1 Techniques
 - 12.1.1.1.1 AMGT
 - 12.1.1.1.2 Protoplast Fusion
 - 12.1.1.1.3 Gene Gun
 - 12.1.1.2 GM Food Crops
 - 12.1.1.2.1 Round-up Ready™
 - 12.1.1.2.2 Bt
 - 12.1.1.2.3 Golden Rice
 - 12.1.2 Disease Management
 - 12.1.3 Micropropagation
- 12.2 Animal Agriculture
 - 12.2.1 Veterinary Medicine
 - 12.2.1.1 Diagnostics
 - 12.2.1.2 Therapeutics
 - 12.2.1.3 Vaccines
 - 12.2.2 Reproductive Manipulation
 - 12.2.3 Molecular Farming

13.0 Environmental Applications

- 13.1 Replacement of Petroleum Products
 - 13.1.1 Bio-fuels
 - 13.1.1.1 Ethanol
 - 13.1.1.2 Biodiesel
 - 13.1.1.3 Methane
 - 13.1.2 Bio-polymers
 - 13.1.2.1 Bio-plastics
 - 13.1.2.2 Packaging Materials
- 13.2 Prevention Environmental Contamination
 - 13.2.1 Sewage Treatment
 - 13.2.2 Bio-leaching
 - 13.2.3 Biodegradeable Materials
- 13.3 Remediation of Environmental Contamination
 - 13.3.1 Bioremediation
 - 13.3.2 Phytoremediation
- 13.4 Environmental Monitoring

14.0 Applications in Forestry

- 14.1 Genetic Enhancement of Trees
 - 14.1.1 Forest Genomics
 - 14.1.2 Somatic Embryogenesis
- 14.2 Pest Management
 - 14.2.1 B.t.
 - 14.2.2 Pheromones
- 14.3 Forest Products
 - 14.3.1 Sap Staining Fungi
 - 14.3.2 Cellulositic Ethanol
 - 14.3.3 Woodstalk™

LUNCH

Day 2 - Afternoon

15.0 Applications in Human Health

- 15.1 Diagnosis of Disease
 - 15.1.1 Types of Disease
 - 15.1.2 Diagnostic Methods
- 15.2 Treatment of Disease
 - 15.2.1 Antibiotics
 - 15.2.2 Growth Factors
 - 15.2.3 Steroids
 - 15.2.4 Gene Therapy
 - 15.2.5 Anti-sense Drugs
 - 15.2.6 Antibodies
 - 15.2.7 Medical Devices
- 15.3 Prevention of Disease
 - 15.3.1 Vaccines
 - 15.3.2 Prophylactic Drugs
 - 15.3.3 Gene Discovery

16.0 The Drug Development Process

- 16.1 Discovery Phase
- 16.2 Preclinical Development
- 16.3 Clinical Development
 - 16.3.1 IND/CTA Application
 - 16.3.2 Phase I Clinical Studies
 - 16.3.3 Phase II Clinical Studies
 - 16.3.4 Phase III Clinical Studies
- 16.4 Drug Approval and Phase IV Studies

Part 4 – THE BUSINESS OF BIOTECHNOLOGY

17.0 The Life Cycle of a Life Sciences/Biotechnology Company

- 17.1 Phases
- 17.2 Case Study: Xenon Pharmaceuticals

18.0 Business Issues for Life Sciences Companies

- 18.1 Clinical Development
- 18.2 Manufacturing
- 18.3 Investment

Part 5 – REGULATION IN BIOTECHNOLOGY

19.0 Regulation of Biotechnology Products

20.0 Ethical Issues in Life Sciences

- 20.1 Biomedical Ethics
- 20.2 Environmental Release
- 20.3 Food Safety & Quality
- 20.4 Animal Ethics
- 20.5 Social & Economic Consequences
- 20.6 Intellectual Property