Biotechnology and Beyond:  
An Introduction to the 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  
2.4.3 Viruses  
2.4.4 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

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Day 1 – Afternoon

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

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 The Applications of Monoclonal Antibodies

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 Biomass as Food
6.2.2 Bioproducts
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 “Oomics” 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
9.8 Summary
Part 3 – 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 & Food Ingredients
10.3 Functional Foods
10.4 Single Cell Protein

11.0 Applications in Marine Sciences
11.1 Bioprospecting of Marine Environments
   11.1.1 Enzymes
   11.1.2 Pharmaceuticals
11.2 Aquaculture

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12.0 Applications in Human Health
12.1 Diagnosis of Disease
   12.1.1 Types of Disease
   12.1.2 Diagnostic Methods
12.2 Treatment of Disease
   12.2.1 Antibiotics
   12.2.2 Growth Factors
   12.2.3 Steroids
   12.2.4 Monoclonal Antibodies
   12.2.5 Gene Therapy
   12.2.6 Antisense Drugs
   12.2.7 Medical Devices
12.3 Prevention of Disease
   12.3.1 Vaccines
   12.3.2 Gene Discovery
   12.3.3 Prophylactic Drugs

13.0 Applications in Agriculture
13.1 Plant Agriculture
   13.1.1 Genetic Engineering in Plants
      13.1.1.1 Techniques
      13.1.1.2 GM Food Crops
   13.1.2 Micropropagation
   13.1.3 Biological Fertilizers
13.2 Animal Agriculture
   13.2.1 Veterinary Medicine
   13.2.2 Reproductive Manipulation
   13.2.3 Molecular Farming

14.0 Applications in Forestry
14.1 Genetic Enhancement of Trees
   14.1.1 Forest Genomics
   14.1.2 Somatic Embryogenesis
14.2 Disease Control in Trees
   14.2.1 B.t.
   14.2.2 Pheromones
14.3 Forest Products
   14.3.1 Sap Staining Fungi
   14.3.2 Bioprocessing of Wood
   14.3.3 Woodstalk™
15.0 Environmental Applications
15.1 Replacement of Petroleum Products
  15.1.1 Bio-fuels
  15.1.2 Industrial Bioproducts
15.2 Prevention Environmental Contamination
  15.2.1 Sewage Treatment
  15.2.2 Bio-leaching
  15.2.3 Biodegradable Materials
15.3 Remediation of Environmental Contamination
  15.3.1 Bioremediation
  15.3.2 Phytoremediation
15.4 Environmental Monitoring

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Day 2 - Afternoon

Part 4 – THE BUSINESS OF BIOTECHNOLOGY

16.0 The Life Cycle of a Life Sciences/Biotechnology Company
  16.1 The Life Cycle
  16.2 Case Study: Xenon Pharmaceuticals

17.0 Business Issues for Life Sciences Companies
  17.1 Clinical Development
    17.1.1 Overview
    17.1.2 Discovery Phase
    17.1.3 Preclinical Development
    17.1.4 Clinical Development
    17.1.5 Summary
  17.2 Manufacturing
  17.3 Investment in Canadian Biotechnology

Part 5 – REGULATION IN BIOTECHNOLOGY

18.0 Regulation of Biotechnology Products
  18.1 Government Agencies Regulating Biotechnology
  18.2 Biotechnology Regulations

19.0 Ethical Issues in Life Sciences
  19.1 Biomedical Ethics
  19.2 Environmental Release
  19.3 Food Safety & Quality
  19.4 Animal Ethics
  19.5 Social & Economic Consequences
  19.6 Intellectual Property