



MASTER OF BIOTECHNOLOGY PROGRAM

Compulsory Course Component

BTC 1820H

BIOTECHNOLOGY IN
AGRICULTURE
&
NATURAL PRODUCTS

Duncan Jones

Fall Term, 2022

MASTER OF BIOTECHNOLOGY

UNIVERSITY OF TORONTO MISSISSAUGA

BTC1820H – Biotechnology in Agriculture & Natural Products

Course Outline (Fall, 2022)

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|-----------------|---|
| Class Location: | Kaneff Centre, Room 112 (KN-112) |
| Class Times: | Mondays & Thursdays, 20-Oct to 8-Dec, 10:00AM -1:00PM |
| Instructor: | Duncan Jones, M.Sc., MBA, PMP |
| Office Hours: | By appointment over zoom. |
| Contact: | duncan.jones@utoronto.ca , text/cell 416-301-6700 |

Course Description

This course is a survey of the various ways biotechnology is being employed commercially in industrial and agricultural contexts (so called “white” and “green” biotechnology). These applications of biotechnology will be compared and contrasted with those of the better known medical/healthcare/(bio)pharmaceutical biotechnology (so called “red” biotechnology).

The technical, financial, and operational aspects of developing and commercializing a variety of products including biocatalysts, biochemicals, and genetically modified (GM) crops will be examined. The potential impact and implications of these biotechnological advances on the economy, the environment, human health, and sustainability will also be discussed.

The material will be presented in a highly interactive manner leveraging case studies and the flipped classroom concept (pre-reads) to facilitate a question and answer (QuickWrites), research (internet searching) and discussion-based environment (participatory).

Each student team will also develop and lead a detailed, well-researched case study which will provide additional context and deepen the students’ understanding of complex technologies and controversial issues.

Course Goals

- To develop a working knowledge of a wide range of biotechnology applications and opportunities, and their associated technologies *i.e.*, **creating** value.
- To analyze the various aspects of commercializing a biotechnology product or process *i.e.*, **delivering** value.
- To gain an understanding of the economic and societal benefits (and risks) of biotechnology as applied to agriculture (green) and natural products (industrial or white) *i.e.*, **capturing** value.
- To further develop soft skills including researching, analyzing, critiquing, discussing, and presenting scientific information from research papers, patents and news sources.

Reading Materials

No textbook is required for the class. Pre-read materials will be posted on Quercus to introduce the materials and to provide additional context for lectures and class discussion. Additional research will be required in some instances.

Marking Scheme/Assignments

Individual class participation, pre-read quizzes, and QuickWrites (10 x 3 = 30%)

With the interactive design, the pre-reads and supporting lecture material will serve as the basis for class discussion, debate and reinforcing challenge events (research and problems). Each class there will be a quiz covering the pre-read material posted on Quercus to be completed in advance of class. During class, there will also be Quickwrite questions that are to be submitted after class.

Two individual assignments (5 x 2 = 10%)

- 1) Following the screening of the film "Food Evolution", a brief (2-3 page) critique of the film's content and opinions is to be prepared.
- 2) Recent press releases and news articles relevant to the course will be posted on Twitter, referencing #BTC1820. These same tweets will be referenced in a dedicated Quercus Discussion Group, and each student is required to post one tweet with a brief (2-3 paragraph) summary and implications statement on a first come-first serve basis and comment on three others.

Team case report and presentation/discussion on a commercial application of biotechnology (15 + 10 = 25%)

A review of a specific and significant agricultural, natural product or industrial biotechnology application and its commercialization or commercial potential is to be presented to the class as a case (~45'). The case will require a pre-read summary document with figures (3-6 pages), a quiz as well as supporting PowerPoint slides with Quickwrites. The presentation should include details of the situation (who/when/where), the challenge or opportunity (what/why), the underlying science, technology, product, and process (what/how), as well as an evaluation of the economic and environmental value. A summary of the issues/risks facing the commercialization efforts, and possible means to mitigate them are to be discussed in class. Teams should challenge the audience and respond to key questions on the topic asked by the class and the instructor as part of their assessment.

Final Exam (35%)

The final exam will consist of a series of approximately 30 short questions (with some choice) based on the underlying concepts outlined in short cases and scenarios. The assigned readings, the cases and materials presented/discussed in class and to a lesser extent the group presentations and tweets, will provide the background for these questions.

Due Dates

The due dates for the assignments are listed in the Course Schedule.

Course Schedule v1.0*

| Session | Date | Topic | Activity | Cases | Assignments Due |
|---------|--------|--|----------|---|---------------------------------------|
| 1 | 20-Oct | Introduction Macroeconomics Sustainability | | Carlson Lokko | |
| 2 | 24-Oct | Enzymes <ul style="list-style-type: none"> ○ Function ○ Classes ○ Applications ○ Biocatalysts | | Rubisco Enogen Xylanase | |
| 3 | 27-Oct | Biocatalysts <ul style="list-style-type: none"> ○ Optimization ○ Microorganisms | | HFCS Taxol Islatravir Beer | |
| 4 | 31-Oct | Green Chemistry <ul style="list-style-type: none"> ○ Metrics ○ Tools ○ Biomass ○ Platform chemicals | | 7-ACA Pregabalin Sitagliptin | |
| 5 | 3-Nov | GMO Debate <ul style="list-style-type: none"> ○ Movie: FOOD EVOLUTION | Debate | Monsanto | Draft team presentations (4, 5, 6, 7) |
| 6 | 7-Nov | Bioremediation <ul style="list-style-type: none"> ○ Soil or Oil Biofuels <ul style="list-style-type: none"> ○ Bioethanol ○ Biodiesel BioMining <ul style="list-style-type: none"> ○ Copper or Uranium | | | Team presentations (4, 5, 6, 7) |
| 7 | 10-Nov | Communicating Science Agricultural Traits <ul style="list-style-type: none"> ○ Herbicidal | | GM headlines Canola Terminator technology | GMO movie critique (1, 2, 3, 5, 6, 7) |
| 8 | 14-Nov | Additional Agricultural Traits <ul style="list-style-type: none"> ○ Insecticidal Heterosis/ Breeding | "Traits" | Heterosis | GMO movie critique (4) |
| 9 | 17-Nov | Trait Technologies <ul style="list-style-type: none"> ○ <i>A. tumefaciens</i> ○ Cell level ○ RNA ○ Genome editing | Tilling | Snow White | Twitter submission |

| Session | Date | Topic | Activity | Cases | Assignments Due |
|---------|--------|--|------------|---|------------------------------------|
| | 21-Nov | NO CLASS | | | |
| | 24-Nov | NO CLASS | | | |
| 10 | 28-Nov | Newer Agricultural Traits <ul style="list-style-type: none"> ○ Product ○ Consumer | | Golden Rice LBFLFK Amflora Potato Arctic Apple Vistive Gold | Draft team presentations (1, 2, 3) |
| 11 | 1-Dec | Woodrill farms | Field trip | | Twitter responses |
| 12 | 5-Dec | Plastics <ul style="list-style-type: none"> ○ Biobased or Biodegradation Pharming <ul style="list-style-type: none"> ○ Medicago or PlantForm Natural products <ul style="list-style-type: none"> ○ Secondary Metabolites Review | | | Team presentations (1, 2, 3) |
| 13 | 8-Dec | Final Exam | | | Exam |

* Subject to revision and rearrangement based on timing.