COURSE COLOUR CODE: HONEYDEW

MASTER OF BIOTECHNOLOGY PROGRAM

Compulsory Course Component

BTC 1700H

MOLECULAR BIOLOGY LABORATORY

Leigh Revers

Summer Term, 2021

MASTER OF BIOTECHNOLOGY
UNIVERSITY OF TORONTO MISSISSAUGA

BTC 1700H – Molecular Biology Laboratory

Course Outline (Summer Term 2021)

1) INSTRUCTOR

Leigh Revers is Director of the MBIOTECH Program. Prior to his current appointment, he headed a research team in the biotech sector, focused on anti-cancer protein therapeutics. He has 30 years of experience with a wide range of experimental techniques covering molecular cloning and expression, and protein purification, amongst others.

2) AIMS & INTENT OF THIS COURSE

BTC1700H is a mandatory, half-credit-bearing laboratory course that is exclusive to the MBIOTECH Program. The course introduces and expands upon fundamental experimental techniques commonly used in biomedical research. It is intended to provide 'hands-on' experience working with nucleic acids and proteins, and comprises an intensive 28-day schedule, running daily during business hours (weekdays, except statutory holidays). During the first, introductory 7 days, students are provided with an overview of key protocols from a practical perspective via a short lecture series, and are provided with same-day, interactive demonstrations of the corresponding experimental techniques in a fully equipped 'wet' laboratory. This is followed by an extended research assignment in which students work in project teams towards expressing and isolating a biomedically relevant, recombinant protein. Teams must successfully design and implement an appropriate research strategy, conduct and manage experiments based on the standard operating procedures provided, collect and analyse data, and prepare and submit their product with appropriate accompanying documentation to meet a pre-arranged deadline. In addition, teams are expected to formulate their ideas about the business potential, be cognisant of budget and expenditures, examine any pre-existing intellectual property, and deliver concise written and oral reports at the end of the course. Typical experimental techniques will include:

- Plasmid DNA isolation,
- Polymerase chain reaction,
- Molecular cloning techniques,
- Heterologous expression in bacteria or yeast,
- Protein affinity purification,
- Western immunoblotting,
- Functional (*e.g.*, enzymatic) assays (as applicable).

Time Commitment:

Practical Time: 176 hours*
Lecture Time: 4 hours*
Tutorial Time: Varies

** All aggregate times are approximate. Two Sessional Instructional Assistants will be appointed to this course.*

3) COURSE TIMES & LOCATIONS

For Summer 2021, BTC 1700H will run on weekdays from **2-Jun** through to **14-Jul**, excepting holidays (See **course calendar** for more).

- *Weekdays, 2-Jun to 11-Jun:* **Demo Days**. There are three components—
  - Introduction & WHMIS, PCR & molecular cloning;
  - Expression & purification;
  - Immunoblots & protein assays.

  Technique Overviews: 10:00AM, Online, concurrent with **Demonstration Sessions:** 10:00AM to noon, 1:00-4:00PM, DV-4077.
- *Weekdays, 14-Jun to 9-Jul:* **Project Days:** 9:00AM to 5:00PM, DV-4077 (Project Days 1-17 + Close-Down Day).
- *Monday, 12-Jul:* **Report Submission Day.** Final Report due by **NOON**.
- *Wednesday,14-Jul:* **Presentation Day:** 2:00-5:00PM, Online.

The first seven days of class (excluding the introductory session on 2-Jun) shall comprise two

teaching components, a short, interactive lecture and discussion in the morning (10:00AM) covering the underlying science as well as the practical considerations behind the selected techniques, concurrent with a practical demonstration session that will run for the rest of the day. Teams nominate ONE representative to attend each Demo Day in person (see below). Some sessions may end early.

The remainder of the course, commencing Monday, **14-Jun**, consists entirely of full-day morning and afternoon laboratory sessions (1:00PM changeover) in which students, operating in teams, pursue a research project. Teams are entirely responsible for the allocation of their time in the lab, and attendance will be monitored, with the proviso that only one student from each team can attend any one session (morning or afternoon), and no student will be permitted to attend two sessions that are chronologically contiguous (the 'tandem' rule). Each team is expected to arrange an **interim meeting** with their supervising SIA.

The course culminates with the preparation and submission by teams of a formal project report and a final **Presentation Day**, at which teams present their findings to an academic panel for review. The deadline for the submission of the written report is **NOON** on Monday, **12-Jul**.

4) COURSE STRUCTURE

The course is structured such that students are first presented with a range of key techniques through the lectured material. The aim is to provide a *scientific overview* of each approach, the *contexts* in which the technique is used, and the *practical aspects* of experimental preparation, set-up and execution. *Safety considerations* are also reviewed.

The demonstrations are designed for students, working in teams, to get a first-hand opportunity to run through each technique and familiarise themselves with the process. Some sessions are accompanied by a questionnaire for feedback purposes.

5) TECHNIQUE OVERVIEWS

These informal lecture-style, interactive overviews are held at 10:00AM online. Attendance online or in person is expected but the former will *not* be strictly monitored. In-person attendance throughout the The technique overviews are divided naturally to cover the following topics:

1) **Molecular Cloning**
   a. PCR, TOPO-cloning, selection, plasmid isolation, restriction analysis.
   b. Subcloning, ligation, transformation, selection.
2) **Expression/Purification**
   a. Culturing, induction, recovery, lysis, clarification, buffering & stabilisation.
   b. Batch affinity purification, column chromatography.
3) **Protein Analysis**
   a. Polyacrylamide gel electrophoresis, visualisation, immunoblotting & detection, protein quantitation methods.

6) DEMO DAYS

Demonstrations are held during the day in the teaching laboratory, Davis Building, DV-4077. These sessions are designed to give each team a chance for its members to try out the various techniques under **direct supervision**. No marks are assigned for the practical work conducted by teams during **Demo Days**. Online or in-person attendance is *mandatory* for all students for all of these sessions (unless special dispensation is sought and granted by the instructor), which will include a WHMIS training course on the first day (2-Jun).

7) TEAM PROJECT

After the conclusion of the lecture and demonstration sessions, on Friday, **11-Jun**, teams will be assigned a sealed project outline. These outlines briefly describe **ONE** coded project that the team must undertake for the remainder of the course. Teams will have a variety of tasks to fulfill as part of each project, which must be submitted as part of the final project report. The first task will be to submit a brief **Workflow Statement**, which is due at **NOON** on Monday, **13 July**. This document, which should look like a conventional flowchart with relevant explanatory notes, will act as a plan of action for the team's experimental strategy and may be subject to change later in the course. However, the order and planning of experiments, the days that they will be performed, the assignment of tasks among the group members, and the overall project management are entirely in the hands of each team. Marks are assigned for the achievement of a series of key milestones, see below.

8) COURSE MATERIALS

Supporting course materials will be provided in the shape of extensive laboratory protocols (SOPs) and Demo Day guidance distributed on Quercus at the commencement of the course.

9) HEAD-TO-HEAD SKILLS CHALLENGES

Teams will be given the opportunity to go head-to-head with another team to perform **Skills Challenges**. Teams nominate a member of their group ahead of time, without knowing the nature of the practical challenge that will be set. Teams may choose the same member more than once for the various Skills Challenges, so long as the 'tandem' attendance rule is not broken. The challenges set will be practical laboratory techniques performed against the clock, and the deliverables will be compared to the other challenger. The team whose challenger produces the best work, as determined by the judges, will receive monetary prizes whereas the challenger with the lowest quality work will be subject to a **Diversion**.

10) DIVERSIONS

Diversions will be assigned to individuals who come last in **Skills Challenges** and must be completed by the team before the next milestone can be granted.

11) FINAL REPORT & PRESENTATION

A final soft-copy report describing in detail the progress achieved during the research project must be submitted **no later than NOON** on Monday, **12-Jul**. Failure to submit the report **on time** will trigger a zero mark for the entire team for this assignment (no exceptions). This deadline is strictly non-negotiable and should be considered to be the final submission time for the material to be presented before a Special Board Meeting of a small biotech firm. Ensure that you have your SIA's sign-off on the report before your team submits.

12) PRESENTATION DAY

Teams must present their findings in a 15-minute oral format, with Keynote or PowerPoint slides, as desired, to a panel of Faculty and SIAs. Each member of the panel will individually grade the performance of the team and assign marks, based on a number of criteria—

- Accuracy and relevance of the scientific discussion;
- Quality of the data and results presented;
- Clarity and confidence of the speakers.

The marks will then be averaged for each team across the panel.

13) MARKING SCHEME & EXPECTATIONS

Seven Components: *(SIA's will assist in marking.)*

1)	Workflow Statement:	4%
2)	Milestones (8):	8 x 3 = 24%
3)	Group Final Report:	20%
4)	Group Presentation:	20%
5)	Individual Mark:	15%
6)	Team Efficiency (budget, management):	15%
7)	Best Bottom Line (**ONE** team only):	2%

Workflow Statement (half-marks permitted):
0 = Failed to submit Workflow Statement on time;
1 = Satisfactory (clearly identifiable lacunae);
2 = Good (some improvement possible);
3 = Very good (very minor improvements possible);
4 = Excellent.

Milestones (half-marks permitted):
0 = Failed to achieve preceding milestone;
1 = Achieved preceding milestone, but failed to achieve current milestone;
2 = Experimental results incomplete (including failure to perform appropriate controls) or unclear: partially fulfilled current milestone;
3 = Success: achieved current milestone and provided unequivocal experimental evidence.

Teams will <u>also</u> receive milestone payments as outlined in the **Project Milestone Checklist** that is included in the team project packs. Teams are encouraged to explore a variety of profit-making and debt financing strategies to improve their purchasing power. Teams can also sue or be sued in the **People's Court** for contractual infringements.

Individual Mark (half-marks permitted):
A mark assigned by the instructor and SIAs based on five equally weighted criteria: (1) competence and dexterity conducting in-person practical work, (2) relevant scientific knowledge, (3) preparedness for the laboratory sessions attended, (4) self-reliance (e.g., appropriate use of online resources, manuals and reference volumes provided to resolve queries without assistance), and (5) contributions to laboratory record-keeping. For each category— **0** = Unsatisfactory; **1** = Satisfactory; **2** = Good; **3** = Excellent.

Team Efficiency (half-marks permitted):
A weighted, relative score reflecting the team's financial success compared to the other 6 teams. The median performing team will score 7/10.