# MICB 448A or 448B – Directed Studies (3 credits Laboratory Course)

The three – credit MICB 448 can be a laboratory research project or a library research project. The laboratory research project is the same as the six – credit MICB 448 except that the time is fitted into one term or approximately 200 hours. In either course the students make arrangements to work in a research lab headed by a Microbiology and Immunology research faculty member or an associate member of the department. The intent of the courses is to provide formal laboratory research experience in a research environment and develop skills for doing scientific research in that field. To develop these skills the student should have regular meetings with the faulty supervisor and/or the project supervisor

The major learning outcomes of the course are:

- Student researchers should be able to apply critical thinking skills to a research problem by:
    - Formulating research questions as the project proceeded.
    - Understanding the design of experiments to answer research questions.
    - Integrating observations and explanations to understand the results and relate the results to each research question.
    - Link experimental results to experimental questions to draw accurate conclusions, recognize the limitations of the results and recognize future significant directions of the research
- Student researchers should be able to effectively communicate their research in oral and written form.

To complete the course the students must:

- Contact eligible faculty members and discuss the possibilities of working in the lab of that faculty member. When there is a mutual agreement between the faculty member and the student then the student reports that agreement to the program coordinator and registers for the course.
- Submit a written outline of the proposed research project to the supervisor and the course coordinator.
- Submit a written progress report to the supervisor and the course coordinator.
- Finish lab work and submit a research article that analyses the project and the results to the supervisor and the course coordinator.
- Defend the project and the report in a formal oral exam attended by the faculty supervisor and another faculty member.

Successful completion of the course will typically require 15 hours of project work each week for three months. The grade will consider:

- The demonstrated critical understanding of the project and the results
- The effort to get results
- The intellectual contribution of the student toward the development of the project
- The quality of the written report and analysis

A first class mark (>80%) should represent a first class achievement in each of the four preceding categories. A more detailed grading rubric is at the end of this outline.

**Eligible faculty supervisors include: the research faculty and associate members listed in the academic calendar at: http://www.calendar.ubc.ca/vancouver/index.cfm?tree=12,215,413,575**

| Faculty member | Summarized research interests: |
|---|---|
| Ninan Abraham | Lymphocytes, cytokines, molecular biology, proteomics, interleukin |
| Tom Beatty | Molecular biology and bio-photovoltaic applications of bacterial photosynthetic complexes; molecular biology of gene transfer agents |
| Sean Crowe | Geomicrobiology |
| Julian Davies | Antibiotics, secondary metabolites |
| Martin Hirst | Epigenetics |
| Lindsay Eltis | Bacterial catabolism of lignin and steroids, *Mycobacterium tuberculosis*, biocatalysts, actinobacteria genomics |
| Rachel Fernandez | Molecular pathogenesis, molecular biology, bacterial disease |
| Brett Finlay | Microbial pathogenesis, molecular biology, mictobiota |
| Erin Gaynor | Bacterial molecular pathogenesis, gene expression, gene array |
| Mike Gold | Molecular Immunology, signal transduction |
| Robert Hancock | Antibiotic resistance; Anti-biofilm peptides; Immunomodulation; Innate Immunity; Complex adaptations in bacteria : stress, swarming motility; biofilm formation |
| Ken Harder | Innate immunity, dendritic cells, gut immunology, innate lymphocytes, tumour immunology, immunotherapy |
| Marc Horwitz | Innate immunity, virology, immunology |
| Francois Jean | Molecular virology; human enveloped viruses; host-virus interactions; broad-spectrum antivirals; therapeutic microRNAs; viral-disease biomarkers |
| Wilf Jefferies | Molecular Immunology, MHC antigen properties |
| Pauline Johnson | Regulation of immune responses, Inflammation, Mucosal Immunology |
| Jim Kronstad | Mycology, genetics, pathogenicity, plant-microbe interactions, fungal molecular genetics |
| William Mohn | Bacterial physiology, microbial diversity, drug targets |
| Michael Murphy | Microbial iron physiology, Enzymes, Structural biology |
| Georgia Perona-Wright | T cells, cytokines and parasite & viral infections |
| William Ramey | Microbial physiology, applied microbiology |
| John Smit | Surface gene expression, biotechnology, molecular biology |
| Curtis Suttle | Marine viruses, marine ecology |

Details of the faculty research can be found at the research links in www.microbiology.ubc.ca

**Winter Session Schedule for MICB 448A (Term 1) or MICB 448B (Term 2)**

1. The course involves lab work, a written project proposal, a progress report, a written report, an oral presentation of the work and an oral exam. You will be expected to spend a minimum of 15 hours per week on the project lab work during September, October, November for MICB 448A or January, February, March for MICB 448B. You should arrange your schedules to carry out at least that much work and select the appropriate due dates for the course that you are enrolled to take.

2. By the second Friday in September or the second Friday in January you should arrange to work in a lab supervised by a member of the Faculty of Microbiology and leave a message for the Undergraduate Program Advisor which names the supervisor that you will work under.

3. Before the third Friday in September or the third Friday in January submit copies of your project proposal to your project supervisor and the Undergraduate Program Advisor. This brief (one or two pages!) project proposal should state or explain your understanding of:

   i) The aim of your project (the idea that you are testing).
   ii) The significance of your project (why is it interesting or important).
   iii) The approach you will use to test the project (the general procedure).
   iv) The time frame for the work (the steps or progress you expect to complete each month).
   v) The potential problems or difficulties you might encounter in the project.

4. On the third Friday in October or the third Friday in February submit a brief (one or two pages!) progress report to the project supervisor and the Undergraduate Program Advisor. This report should state:

   i) Major accomplishments in the work to that time.
   ii) Major problems in the project.
   iii) Significant changes in the aim or approach for the project.
   iv) Remaining experiments that you expect to complete before writing up the final project report.

5. Complete the lab work for the project by the third week of November or the third week of March. By the first Friday in December or the first Friday in April, before the start of the formal examination schedule, submit the written report of your work to your project supervisor, the Undergraduate Advisor and the member of the Faculty of Microbiology chosen to examine your work. This written report should be in the style of the Journal of Bacteriology or Journal of Immunology or the Journal of Virology. The report can use a single column format rather than the two column format but the sections, figures, tables and references should conform to the ASM style. It is normally ten to fifteen printed pages including tables and figures.

6. Your supervisor will schedule your oral exam and submit your mark to the Undergraduate Program Advisor. The exam will be scheduled a week or more after submitting the report to allow your examiner adequate time to read your report. Oral exams for MICB 448A should be held in December or January. Oral exams for MICB 448B must be held in April if you are intending to graduate in May.

7. Once you know the date and time for your exam you should book a departmental seminar room for the two hours needed to present the results.

8. The oral exam will require you to formally explain your project and results to the supervisor and the chosen examiner for 10 to 20 minutes. This presentation will be followed by 20 to 30 minutes questioning by your supervisor and your examiner to assess your understanding of the intent of the work, the presented results, the relationship of your work to other work in that field, and your understanding of the techniques involved in your work.

9. The formal presentation at the beginning of your exam should consist of an organized oral seminar presentation covering the salient ideas, experiments, results and conclusions of your thesis work. It does not need to include all your work and should present the major points of the work rather than simply giving a chronological description of the results of each experiment. It usually includes 8 to 12 slides of the major graphs, tables or design features that you have presented in the written report.

10. The mark submitted to the Undergraduate Program Advisor by the supervisor will be a cumulative grade determined by your effort in the lab, your understanding of the work and procedures, the quality of each draft of the written report, and your performance in the oral exam. The grading rubric that should be applied is at the end of this outline.

11. The final mark will usually be the mark submitted by the supervisor but up to 20 percent of the mark will be penalized unless there are punctual submissions of an adequate project proposal, an adequate progress report and a suitable final report. Each mark, proposal or report submitted late will be penalized unless a prior exemption has been requested to delay the report or extend the project.

12. If you are having difficulties with your project that are awkward to describe in writing please discuss the problem with the supervisor or the Undergraduate Program Advisor.

**Summer Session Schedule for MICB 448A**

1. The summer course requires:
   (a) Eight weeks of laboratory research work at 20 hours per week.

   (b) By the end of the first week submit copies of your project proposal to your project supervisor and the Undergraduate program Advisor. This brief (one or two pages!) project proposal should state or explain your understanding of:

      i) The aim of your project (the idea that you are testing).
      ii) The significance of your project (why is it interesting or important).
      iii) The approach you will use to test the project (the general procedure).
      iv) The time frame for the work (the progress you expect to complete each month).
      v) The potential problems or difficulties you might encounter in the project.

   (c) By the end of the fifth week you should submit a brief (one or two pages!) progress report to the project supervisor and the Undergraduate Program Advisor. This report should state:

      i) Major accomplishments in the work to that time.
      ii) Major problems in the project.
      iii) Significant changes in the aim or approach for the project.
      iv) Remaining experiments that you expect to complete before writing up the final report.

   (d) During the last week write a final report in the style of Journal of Bacteriology or Journal of Immunology or Journal of Virology and submit a paper copy of the report to the project supervisor, an examiner and the Departmental Undergraduate Advisor. The examiner is a faculty member of the Department of Microbiology chosen by the project supervisor to assess the written work and participate in the oral exam. The report is typically ten to fifteen printed pages including tables and figures.

   (e) The oral exam consists of a short formal 10 - 15 minute presentation (seminar) by the student followed by a question period. During the exam the chosen examiner and the supervisor can ask questions about the oral presentation, the written report and general related background knowledge in order to assess the student's understanding of the research project. This oral presentation should be scheduled to allow a few days for the examiner to read the written report and for the student to prepare any necessary slides or overheads for

explaining the project details. It should cover the essential ideas, background, results and conclusions from the research project.

2. The grade submitted to the Undergraduate Program Advisor by the supervisor will be a cumulative grade determined by your effort in the lab, your understanding of the work and procedures, the quality of each draft of the written report, and your performance in the oral exam. The following grading rubric should be applied.

**Grading Rubric for MICB 448**

The **grade between 95 - to - 100%** represents outstanding work. To fall in this range the student and the work must demonstrate all of the following features. The student did not need to complete the entire original proposal but should have made some progress.

- The **student could work relatively independently**. The student demonstrated that they knew the limitations of the study, the place that the work fits in the field, the significance of the project and the next steps in the project.
- The student consistently participated in the development of the project by researching background outside the original references provided by you. Throughout the project the student contributed significant insight into the results and technical problems rather than passively expecting you or their immediate lab supervisor to interpret their results, provide explanations and solve their problems. If there was no dialogue concerning the meaning of the results during the meetings of the supervisor and the student then the student was probably not an active participant in the ongoing development of the project.
- The student put in at least 15 hours of active work per week on the project in an attempt to get results and complete the proposal. The student was technically competent. The student kept adequate records and did not need to keep returning to get instructions repeated. The work areas were organized and safe.
- The first copy of the final report was organized so that it had a professional appearance and excellent flow. There were no significant spelling or grammatical errors, all the important observations and controls were included and the irrelevant observations were omitted. Critical thought and accurate consistent analysis was evident. The discussion clearly referred to the observations and clearly related the observations to the field of study by citing relevant references. The conclusion was an accurate statement that was based on the observed experimental results. The conclusion addressed the experimental purpose.
- The style was appropriate for an ASM journal submission and the content placed in the title, abstract, methods, results, discussion and reference sections was appropriate.

The **grade between 85 - to - 94%** represents very good work. To fall in this range the student and the work has the following features. The student did not need to complete the entire original proposal but should have made some progress.

- The student demonstrated that they knew the limitations of the study, the place that the work fits in the field, the significance of the project and the next steps in the project.
- The student consistently participated in the development of the project by researching background outside the original references provided by you. Throughout the project the student has been contributing significant insight into the results and technical problems rather than passively expecting you or their immediate lab supervisor to interpret their results, provide explanations and solve their problems. During meetings between the student and the supervisor there was significant dialogue concerning the results.
- The student put in at least 15 hours of active work per week on the project in an attempt to get results and complete the proposal. The student was technically competent. The student kept adequate records and did not need to keep returning to get instructions repeated. The work areas were organized and safe.

- The first copy of the final report was organized so that it had reasonable flow. There might have been **a few significant spelling or grammatical errors, but the important observations and controls were included** and the irrelevant observations were omitted. **Some critical thought and analysis is evident and there were adequate references to relate the observations and conclusions to the field**. **The conclusion was an accurate statement that was based on the observed experimental results.** The conclusion addressed the experimental purpose.
- The style was appropriate for an ASM journal submission and the content placed in the title, abstract, methods, results, discussion and reference sections was appropriate.

The **grade between 80 - to - 84%** represents good work. To fall in this range the student and the work has the following features. The student did not need to complete the entire original proposal but should have made some progress.

- The student demonstrated that they knew the limitations of the study, the place that the work fits in the field, the significance of the project and the next steps in the project.
- The student interpreted the observations and contributed some insight into the results and technical problems **but tended to rely on you or their immediate lab supervisor to provide explanations and solve their problems. There was some dialogue but the dialogue was limited.**
- The student put in at least 15 hours of active work per week on the project in an attempt to get results and complete the proposal. The student was technically competent. The student kept adequate records and did not need to keep returning to get instructions repeated. The work areas were organized and safe.
- The first copy of the final report was organized so that it had reasonable flow. **There might have been be a few significant spelling or grammatical errors**. **Most** of the important observations and controls were included but **the coverage was uneven so that one or two important observations might have been deemphasized or some irrelevant observations might have been included**. **Some critical thought and analysis was present and there were adequate references to relate the observations and conclusions to the field**.
- The style was appropriate for an ASM journal submission and the content placed in the title, abstract, methods, results, discussion and reference sections was appropriate.

The **grade between 76 - to - 79%** represents reasonable work. To fall in this range the student and the work has the following features. The student did not need to complete the entire original proposal but should have made some progress.

- The student demonstrated that they knew the limitations of the study, the place that the work fits in the field, the significance of the project and the next steps in the project.
- The student interpreted the observations and contributed some insight into the results and technical problems **but tended to rely on you or their immediate lab supervisor to provide explanations and solve their problems. There might have some dialogue but it was limited.**
- The student put in at least 15 hours of active work per week on the project in an attempt to get results and complete the proposal. The student was technically competent. The student kept adequate records and did not need to keep returning to get instructions repeated. The work areas were organized and safe.
- The first copy of the final report **was a bit difficult to follow because the presentation did not flow logically or some key points were not very clear**. **There might have been a few significant spelling or grammatical errors**. Most of the important observations and controls were included but **the coverage was uneven so that one or two important observations were missing or several irrelevant observations were included**. **The critical thought and analysis was limited but there was some integration of the observations and adequate referencing was used in an attempt to relate the observations to the field of research**.
- The style was **mostly** appropriate for an ASM journal submission but the content placed in the title, abstract, methods, results, discussion and reference sections **was not consistently appropriate**.

The **grade between 72 - to - 75%** represents adequate work. To fall in this range the student has done the work but had two or more of the following limitations. The student did not need to complete the entire original proposal but should have made some progress.

- The student interpreted the observations and contributed some insight into the results and technical problems but **tended to rely on you or their immediate lab supervisor or other students to provide explanations and solve their problems.**
- The student put in at least 15 hours of active work per week on the project in an attempt to get results and complete the proposal. The work was technically competent and the student kept records and did not need to keep returning to get instructions repeated. The work area was organized and safe.
- The first copy of the final report **was sloppy and poorly organized so it did not flow. Some key observations were missed**.
- **Critical thought and analysis was present but was very limited so the work tended to be descriptive rather than analytical. Documented relationships between the field and the research were limited to one or two novel references. The analysis was difficult to follow because the arguments were not consistently related to the observations or contradictory observations were not recognized or the conclusion was inappropriate for the evidence**.
- The style was generally appropriate for an ASM journal submission but the content placed in the title, abstract, methods, results, discussion and reference sections was not consistently appropriate.

**Grades below 72%** represent poor work or effort. They are suitable if

- The student did not understand the significance of the project in relation to the field.
- **The student put in less than 15 hours per week and did not get results.**
- **The report is difficult to read because it was not focused on the research question or it had numerous grammatical problems or it missed many key observations or it was mostly just descriptions with no significant critical thought and analysis.**

**Grades of 50- 55%** represent marginal work or understanding

- The student did adequate technical work, completed the report and the exam but did not understand the project or the meaning of the results.

**Grades below 33%** indicate that the student might have done good technical work but did not complete the report or the oral exam.

## Examples of Evaluations for MICB 448 and 449

### *Evaluation Example #1*

*Student:*

*Supervisor:*

*Title of project:*

*Student evaluation*

*Work and effort: 45/50*

*Initiative, problem solving, understanding: 47/50*

*The student had previously been a co-op student in my lab, and for the directed studies undertook a project related to the work that was done previously, which included curation of related genes from the literature. The new project was to perform meta-analysis of gene expression data from published studies. The student had to learn quite a few new skills and*

*concepts for this project and was successful. The student made relatively few mistakes, and was quick to correct any that were made. The student responded well to supervision and criticism, and was generally accurate in the predictions of how long tasks would take (allowing for some typical time management struggles around exam times, etc.), and was proactive in pursuing lines of inquiry. Overall the student got a great deal done, probably at least 75% of what we had originally proposed (which was intentionally ambitious). The network analysis is incomplete, but I was not expecting student to get so far in the project as to be able to tackle this in a serious way, so I was impressed that the student got something done. It was a bit rushed but overall the student took the project very seriously, worked hard, and produced what the student promised. The best testament to the students success is that we are attempting to continue the work and shape it into a manuscript for publication. The student also shared an award for presenting a poster at the MURC.*

*Thesis evaluation*

*Thesis mark: 92/100*

*The thesis is well put-together, clearly written and very few if any typographical errors. The language is sometimes a little bit informal for this type of document ("we took a look at ..." and "to see if there are any noticeable differences"). Overall, the writing is better than what I often encounter with students at this (or even higher) level of training, but this does reflect substantial revision that the student got help with. In terms of content, the introduction is not particularly deep, but shows a good grasp of the essentials of the genetics of the project and the motivation for the study. The presentation of the "top genes" could have been a bit better organized; there are heat maps of p-values, but also the dot charts. The discussion is quite good but would have benefited from an opening paragraph summarizing the contributions. There are little things that could have been done to extend the findings; for example to provide a statistical evaluation for the results shown at the bottom of figure 9 (the "barcode").*

*Oral presentation*

*Presentation: 94/100*

*Questions: 95/100*

*The presentation was well-practiced and the student did an excellent job of answering questions. The slides were clear and well-organized. In terms of speaking style, the student speaks quite rapidly and might benefit from slowing down just a little. I know that the student put a lot of time into preparing and practicing, and responding to feedback, before the final presentation.*

## ***Evaluation Example #2***

*Student:*

*Supervisor:*

*Title of project:*

*Overall grade: 85/100*

*Student evaluation (40% of final grade)*

*Work and effort: 47 /50*

*Initiative, Problem solving, understanding: 45 /50*

*The student was hard-working and motivated. The student began working on the project in September, and continued to work regularly throughout the year. The laboratory work was careful and precise with good notes. Excellent progress was made in the project and early technical problems were solved. The student worked independently but could have asked for more assistance at times.*

*Thesis evaluation (30% of final grade)*

*Thesis Mark: 83 /100*

*The thesis was carefully prepared and is properly formatted. Each section had the appropriate content yet was fairly concise. The overall quality of the writing is high, few errors were found and the references were appropriate. The work was described accurately and some critical analysis was provided. Some data such as gels showing the quality of the recombinant protein was absent. A good review of the literature was provided in the introduction but the connection to the results and conclusions was cursory.*

*Oral presentation (30% of final grade)*

*Presentation: 42 /50*

*Questions: 35 /50*

*The student provided a 30 minute oral presentation of the work. This was clear, logical and of better overall quality than the thesis. Much of the data (SDS-PAGE gels) absent in the thesis was nicely presented. In the presentation, the student demonstrated a good understanding of the project but again failed to cover related literature adequately. The student seems to lack confidence in the work and thus was overly cautious in drawing conclusions and making comparisons. In the subsequent oral examination, the student fielded questions from the examiner for 20 minutes, followed by a further 5 minutes of questions from myself. Together, the questions covered many aspects of the student's project. Overall, the student's handling of the questions was deemed to be poor in relation to the thesis and presentation. The student appeared nervous and had difficulty recalling fact such as the definition of an extinction coefficient. With some prompting she was able to rationalize answers to some questions. The performance in the exam was below expectations from previous one on one interaction.*

## ***Evaluation Example #3***

*Student:*
*Supervisor:*
*Title of project:*

***Overall grade: /100***
***Student evaluation*** *(40% of final grade)*

*Work and effort:* *43 /50*
*Initiative, Problem solving, understanding:* *39 /50*

*Comments (Provided as example): The student was hard-working and motivated. The student began working on the project in September, and continued to work regularly throughout the year: the student worked diligently and put in additional hours whenever the student reasonably could (i.e., during holiday breaks and when not busy with other courses). The work at the bench was careful and precise. However, the student did not always display the best comprehension of the project and the techniques involved. To be fair, I think that the student is capable of better. I believe that during this project, the student was often overworked and frazzled with other unrelated jobs and volunteer responsibilities.*

***Thesis evaluation*** *(30% of final grade)*
*Thesis Mark:* *78 /100*

*The thesis was carefully prepared and is properly formatted. Each section had the appropriate content yet was fairly concise.*

*The overall quality of the writing is high and the overall flow of the ideas is good. The thesis contains a remarkably low number of grammatical, typographical and stylistic errors. Perhaps the most notable exception was the use of protein names to identify DNA fragments in the agarose gels (Figs. 3 and 4). Also, it was unclear what is meant by "Peptides were sequenced against the …".*

*The Abstract and Introduction were very clear, quite comprehensive and concise.*

*The Materials and Methods section contained all of the relevant information. Relevant experimental techniques were clearly described with the exception of the description of the purification of cell extracts over affinity resins: exactly how were the extracts handled?*

*The Results and Discussion sections were logically organized. The cloning results were well documented and described, although it was not necessary to describe unsuccessful cloning experiments (Fig. 5). The main weaknesses are the lack of some controls and the lack of some data. Among the controls, it would be good to know whether the unidentified affinity-purified bands were detected in cells transformed with empty vector. With respect to the data, the changes in the in vitro cleavage assay should have been stated with reference to the data (Fig. 10) instead of simply stating that no cleavage was observed. Similarly, the gel bands should have been identified, even if they were not viral proteins.*

*Conclusions were reasonable, and the future directions were good.*

*The references were appropriate and correctly formatted but some were incorrectly cited in the text.*

***Oral presentation*** *(30% of final grade)*

*Presentation:* *86 /100*
*Questions:* *74 /100*

*The student provided a 30 minute oral presentation of the work. This was clear, logical and of better overall quality than the thesis. In the presentation, the student demonstrated a clear understanding of the project.*

*In the subsequent oral examination, the student fielded questions from the examiner for 20 minutes, followed by a further 15 minutes of questions from myself. Together, the questions covered most aspects of the student's project. Overall, the student's handling of the questions was deemed to be adequate: while the student handled some questions correctly, the student seemed to be lacking some important knowledge and could have shown a better ability make a quick decision and give an answer quickly. For example, the student did not know the rationale for using certain strains. Similarly the student did not deduce the inherent advantage of using insect cells to express the viral replicase.*