Statistical Sciences
UNIVERSITY OF TORONTO

STA288H1 – Statistics and Scientific Inquiry in the Life Sciences

Course & Instructor Information

STA288H1 – Statistics and Scientific Inquiry in the Life Sciences

Lecture Section	Lectures & Tutorials	Computing Lab*
LEC0101	Tuesdays 11am -1pm in WB116 Thursdays 11am-1pm in WB116*	Thursdays 11am-1pm *(check schedule on last pages of this syllabus for weeks; locations posted on Quercus)*

** Refer to the schedule on the last page of this syllabus and the Quercus course website for more information regarding the class/tutorial/lab schedule and your assigned section and computing lab room locations.*

Statistics & Scientific Inquiry Instructor:
Dr. Bethany White
Associate Professor, Teaching Stream
Department of Statistical Sciences

Scientific Inquiry Instructors:
Drs. Bill Ju and Jasty Singh
Associate Professor, Teaching Stream, and Research Fellow, Human Biology Program

Instructor Contact Information & Office Hours

Dr. White's STA288 Office Hours: Tuesdays 1pm (after class)-2:30pm & Wednesdays 12:30pm-2pm in SS 6006 (unless otherwise indicated on Quercus)

Drs. Ju/Singh STA288 Office Hours: Wednesdays 2pm-3:30pm & Thursdays 1-2:30pm in Wetmore 105 (unless otherwise indicated on Quercus)

Note: Watch the Announcements in the Quercus site for notifications about changes in office hours.

All course content or course administration questions must be posted to the online Discussion Board on Quercus or brought to office hours. These types of inquiries will not be addressed by email.

Any messages of a more personal nature (e.g., providing medical documentation for a missed lab assignment) should be emailed to the instructors (through Quercus; not to their utoronto email addresses) or brought to their scheduled office hours (above). You can expect a response within about 48 hours (Monday-Friday) to a Discussion Board posting or to an email. **To email your instructors, click on the Inbox section of your Quercus page, click on the feather (i.e., quill) icon on the top right of the page to compose your message, select "Teachers" within STA288 as the recipients and use an informative subject line. All three of your instructors will receive this message.**

Note: To discourage content cramming, content-related questions posted within the 24 hour period preceding due dates for any course based assessments (including final exam) will not be addressed by the instructors/TAs until after the due date (or final exam).

Calendar Description

Introduction to statistics and its connection to all stages of the scientific inquiry process. Issues around data collection, analysis and interpretation are emphasized to inform study design and critical assessment of published research. Statistical software is used to conduct descriptive and inferential statistics to address basic life sciences research questions.

Prerequisite: BIO230H1/BIO255H1
Exclusion: STA220H1, PSY201H1, GGR270H1, ECO220Y1, ECO227Y1, SOC202H1, EEB225H1, HMB325H1, STA248H1, STA261H1, PCL376H1

Course Learning Outcomes

In this course you will:

- See the relevance of statistical issues in all stages of the life sciences research process.
- Select appropriate statistical methods to address basic life sciences research problems.
- Use statistical software to explore data and create numerical and graphical summaries that address life sciences research problems.
- Use statistical software to conduct appropriate statistical inference procedures (e.g., compute p-values, effect sizes, confidence intervals) to address a life sciences research problem.
- Draw scientific conclusions from graphical and numerical summaries of life sciences data and results of inferential procedures (e.g., p-values, effect sizes, confidence intervals).
- Identify strengths and weakness in study designs and analyses in published life sciences research.
- Design studies to address basic life sciences research problems.
- Recognize when standard statistical procedures are not appropriate and know to seek statistical expertise early in the research process.

Textbook

Practice of Statistics in the Life Sciences (4th edition) - Baldi and Moore. W. H. Freeman and Company.
An electronic version will be made available free-of-charge from the publisher. Information on how to access create an account to Sapling Plus (which includes the textbook) will be made available on our course website (in Quercus). Alternatively, a loose-leaf hard copy is available for purchase through the Bookstore (ISBN # 9781319200602).

iClickers

We will be using iClickers in lecture for participation grades and to provide feedback on your learning. There is flexibility in the grading scheme (see below) so that you do not need to use an iClicker if you do not wish to do so. If you wish to participate with iClickers and do not already have an iClicker or an iClicker Cloud subscription for another course, you can purchase either a 6-month iClicker Cloud subscription so you can participate using your own device in class (ISBN #9781319140175), or purchase a physical iClicker from the Bookstore so you won't need your own internet-enabled device to participate. **There are a limited number of iClickers available for borrowing from the HMB office for the semester. See Quercus for more information.**
NOTE: A 6-month iClicker Cloud subscription is included with the loose-leaf version of the textbook at the Bookstore

Statistical Software - R

` is an open source statistical package that is widely used in academia, research and industry and is quickly becoming a standard platform. It is available for free download from: http://cran.ca.r-project.org for use on Windows, Mac OS, and Linux (there is also a version for use on Android). You will need to be familiar with R code and output and be able to generate and interpret R code/output in the STA288 computing labs and on your lab assignments (4 assignments worth 5% each).

Quercus Course Site

We will be using a new learning management system that is similar to Blackboard (called ***Canvas***). The University of Toronto will be moving from "Portal" to "Quercus" in 2018, and STA288 has been selected for early adoption. All questions about the course can be posted on the Discussions area of our Quercus course site and if you need to email the instructors for a more personal reason, you should use the "Conversations" tool in Quercus available by clicking on the Inbox icon and selecting the STA 288 "Teachers" as recipients. It is your responsibility to check this Quercus site regularly (especially the Announcements section) and to monitor your utoronto email inbox for messages about the course. Important announcements, information about how to get set up with iClickers/iClicker Cloud and R, information about assessments, help (via the Quercus Discussions), your grades, etc. will be available on the Quercus site and course assessments will need to be submitted there. Outline lecture slides will also be posted there in .pdf format, 1 slide per page only, by 11:59pm the night before lecture. Alternative file formats will not be available. **Note that complete slides/lecture material used in class will not be posted or distributed in any form under any circumstances.**

`s mentioned above, the Discussion Board tool is enabled on the Quercus website.** Post questions and respond to your peers' questions about course content (e.g., classes, textbook readings and practice questions, etc.) or general course administration there. It will be monitored on a regular basis. If you email your instructors with a course content or general administration question, you will be directed to the Quercus Discussions section. This is an open Discussion Board and an extension of our classroom learning community so please be respectful of one another. Derogatory, discriminatory, or otherwise inappropriate language or topics will be removed and dealt with at the instructors' discretion.

Computing Labs & Tutorials

There will be four (4) mandatory 2-hour computing labs and four (4) mandatory 2-hour tutorials during the term:

Labs – The purpose of these computing labs is to provide you with hands-on experience using the statistics software, R, to summarize data and to run statistical procedures and to extract meaning from results. Each lab will involve a short demonstration; then you will work through exercises and complete a lab assignment. Your lab assignment must be submitted through Quercus by the 6pm the following day. More information about the labs and the lab assignments will be posted on Quercus.

Tutorials – The purpose of these tutorials is to reinforce concepts from class and to support your progress with the course project. During these tutorials, we will revisit the more challenging concepts discussed in previous classes and you will have an opportunity to work with your group members on your course project with support from the instructors and/or TAs.

You must attend your assigned tutorials and labs at the location posted for you on Quercus - you will not earn credit for attending another location/time/week.

Questions & Additional help

Have a course-related question? Need extra help with the material? Here are some options:

- **Have a question about STA288 course material, R, or general administration of the course?**
  - Review the questions already posted in the Quercus Discussions and if your question hasn't already been addressed, post it there with an informative subject line.
  - Visit the instructors' office hours (on page 1 of this syllabus) or TA office hours (to be announced on Quercus) or bring your question(s) to your tutorial. Note that the TAs will not be available by email or for extra help outside labs/tutorials or any office hours they hold.
- **Need to reach the instructor about a private or personal matter (e.g., illness, grades)?** Do not post personal questions in Quercus Discussions! Do not send messages to your instructors' utoronto emails either; instead, to email your instructors, click on the Inbox section of your Quercus page, click on the feather (i.e., quill) icon on the top right of the page to compose your message and select "Teachers" within STA288 as the recipients. Be sure to use an informative subject line. All three of your instructors will receive this message. ***Quercus e-mail to your instructors should only be used for emergencies or personal matters.*** If you email a question to the instructor about course material or course administration, then you will be asked to post your question on the Quercus Discussions – course content and general administration questions will not be answered via email.

Grading Scheme & Assessment Information

Your course grade will be automatically calculated using the grading scheme that gives you the highest possible grade based on your participation, assignments, project and final exam:

Assessment	Scheme 1	Scheme 2
In-class participation (iClickers/iClicker Cloud)	5%	0%
Attendance/participation in tutorials	4% (1% for each)	4% (1% for each)
Lab assignments	20% (4 x 5% each)	20% (4 x 5% each)
Course project - research proposal (due Feb 15)	6%	6%
Course project - research report (due Apr 4)	25%	30%
Final Exam	40%	40%

No special rounding rules or individual grade adjustments (e.g. to meet GPA cut-offs, minimal requirements for programs, etc.) will be used to calculate course grades. No special reweighting of assessments or extra work will be accepted to account for perceived poor performance, nor to account for any assessment(s) that have been missed without accommodation. There are no exceptions to these policies.

Course project (group project):

To give you experience with the scientific inquiry process, you will have the opportunity to conduct a research study in STA288. Students will undertake this as a collaborative exercise with a small group of peers within their tutorials (3-4 students who are in the same assigned tutorial section – *groups cannot consist of students outside of their assigned tutorial section*). The project is broken down into two parts – the Research Proposal and the Research Report.

Course Project - Research proposal

In the Research Proposal, you will work with your group members to identify a life sciences/biology-related research question based on a review of the literature, and describe a plan to explore that research question. All group members will be asked to contribute to the proposal equally and provide an outline of their involvement in this proposal at the time of submission to Quercus. Further assignment guidelines and an evaluation scheme will be provided at least one week prior to the due date. One group member will submit the proposal on behalf of the group, but late penalties of ***20% per calendar day*** will apply equally to all group members. The assignment must be submitted to Quercus by ***February 15th at 6 PM***. If you have further questions about the assignment, require additional resources, or have technical problems with your submission, please contact your instructors (i.e., choose the STA288 "Teachers" as the recipient) through the Quercus Inbox right away. Instructors/TAs will provide you with feedback, which should be integrated into your final research report (below).

Course Project - Research report

We will be providing students in this course an opportunity to follow up their initial research proposal by sampling data from a virtual population on **The Island** (a virtual environment that has been created by the University of Queensland). You will receive an email to your utoronto email granting you access to the site and inviting you to change your password to the site. Within your groups, you will collect, summarize and analyze data, as well as describe your methods and present the conclusions of your study. ***This is a distributed collaborative project – although the group will all receive a common mark (75% of the final grade on this assignment), 25% of the grade will come from anonymous peer evaluations from within the group and a table highlighting the contributions of the individual to the final assignment.*** Since this is intended to simulate a collaborative research experience using a design process surrounding a research question, data collection methods, data presentation and analysis as well as inference, the assignment will be due at the end of the semester (***April 4th at 6 PM***). Full details of the assignment including guidelines and an evaluation scheme will be provided in February to allow student members to plan accordingly. The assignment will be submitted to a Dropbox on Quercus by the due date by one member of the group. ***20% late penalties per day will apply to each member of the group*** (see policies on work submitted late above).

iClickers/ iClicker Cloud

iClickers (or iClicker Cloud) will be used to promote engagement, provide feedback on your understanding during classes, as well as to give you credit for class participation. Note that iClicker/ iClicker Cloud participation is optional – an alternate grading scheme is available for students who choose not to participate this way (see Grading Schemes above).

iClicker questions will be asked during class. The proportion of questions you answer (starting the 3rd week of classes) will determine the fraction of the available participation grade (5%) that you earn, as shown in the table on the right. There will be around 3 clicker questions per class. However, some classes will have more or fewer questions. Clicker participation only requires that you try; you do not have to get the questions correct to earn this part of your course grade. Notice that you can miss up to 25% of the clicker questions for any reason without affecting your grade. **Due to this flexibility, there is no accommodation for missed clicker participation for any reason (e.g., legitimately missed lectures, technical problems, incorrectly registered iClicker/ iClicker Cloud). However, there is flexibility in the grading scheme to shift this 5% to the final group project if that results in a higher course grade for you.**

% Questions answered	Class Participation Mark (/5%)
$0 \leq$ % answered < 5	0%
$5 \leq$ % answered < 25	1%
$25 \leq$ % answered < 45	2%
$45 \leq$ % answered < 60	3%
$60 \leq$ % answered < 75	4%
$75 \leq$ % answered ≤ 100	5%

It is your responsibility to register your iClicker device (see http://teaching.utoronto.ca/ed-tech/teaching-technology/iclickers/registering-your-iclicker/) or set up your iClicker Cloud account correctly (information is posted on Quercus) to ensure that your iClicker participation is recorded properly. Use of an iClicker device or iClicker Cloud account associated with a UTORid other than your own or granting permission for someone else to submit answers on your behalf in your absence are academic offences and will be dealt with as such.

Lab Assignments

There will be four (4) equally weighted assignments to be completed **independently** (no collaboration permitted). Assignments must be completed and submitted through the appropriate Quercus site/link by the deadlines to avoid late penalties. The lab assignments are due by 6pm the day following your lab. Late assignments will be accepted through Quercus with a penalty of **20% per calendar date** (e.g., if the submission deadline is 6pm on Feb 8, and you submit at any time between 12:00am and 11:59pm on Feb 9, your maximum possible score will be 80% - e.g., if you earn 76%, then your recorded grade will be 56%, etc.). **To earn credit on these lab assignments, you must be present at the lab for your assigned section.** If you were not present at your section's lab, 0% will be recorded, even if you submit a lab assignment - you will still receive feedback on the work you submitted, but your grade will be 0%.

- If a lab/assignment is missed for a valid medical reason, you must email your instructor immediately through Quercus by choosing STA288 "Teachers" as recipients, then submit the University of Toronto Verification of Student Illness or Injury form (http://www.illnessverification.utoronto.ca) to your instructors within **one week** of the assignment deadline. The form will only be accepted as valid if the form is filled out according to the instructions on the form. **The form must indicate that the degree of incapacitation on academic functioning is moderate, serious, or severe in order to be considered a valid medical reason for missing assignments, and it must cover at least your lab day (or the following day – the due date) in order to be deemed valid. If the form indicates that the degree of incapacitation on academic functioning is negligible or mild or does not cover your lab day (nor the following day – the due date), then this will NOT be considered a valid medical reason.**
- Other reasons for missing an assignment or lab will require prior approval by your instructor. If approval is not granted in advance for non-medical reasons then you will receive a grade of 0% for the missed lab/assignment.
- Note: If you submit an assignment, it will be assumed that you deemed yourself fit enough to do so and your grade will stand as calculated. No accommodation will be made based on claims of medical, physical, or emotional distress ***after*** the fact.
- **Accommodation for missed assignments** - There are no extensions, nor make-ups for labs and assignments. You may submit your assignment late, with penalty (as described above). If accommodation is granted by your instructors for a missed lab/assignment, the weighting for that assignment will be shifted to your other three (3) lab assignments; otherwise 0% will be recorded for your missed lab/assignment. **NOTE: The labs are an important component of this course. So, at most one (1) lab can be accommodated as described above. Any other labs/assignments that are missed (even for legitimate reasons) will have 0% recorded for them.**

Tutorial Attendance/Participation

The four (4) tutorials are an important component of the course. Therefore, attendance and participation in your ssignment tutorial section is expected and will be recorded at each tutorial. There are no make-ups for missed tutorials. If a tutorial is missed for a valid medical reason, you must email your instructor immediately through Quercus by choosing STA288 "Teachers" as recipients, then submit the University of Toronto Verification of Student Illness or Injury form (http://www.illnessverification.utoronto.ca) to your instructors within **one week** of the tutorial. The form will only be accepted as valid if the form is filled out according to the instructions on the form. **The form must indicate that the degree of incapacitation on academic functioning is moderate, serious, or severe in order to be considered a valid medical reason for missing assignments, and it must cover your tutorial day in order to be deemed valid. If the form indicates that the degree of incapacitation on academic functioning is negligible or mild or does not cover your tutorial day then this will NOT be considered a valid medical reason.**

Other reasons for missing a tutorial will require prior approval by your instructor. If approval is not granted in advance for non-medical reasons then you will receive 0% for attendance/participation for your missed tutorial.

If accommodation is granted by your instructors for a missed tutorial, the weighting for that assignment will be shifted to your attendance/participation grades for your other three (3) tutorials; otherwise 0% will be recorded for your missed tutorial. **NOTE: As mentioned above, the tutorials are an important component of this course. So, at most one (1) tutorial can be accommodated as described above. Any other tutorials that are missed (even for legitimate reasons) will have 0% recorded for them.**

Final exam

There will be a **3-hour exam (combination of multiple-choice and written answer)** scheduled but the Faculty of .rts and Science during the April exam period. You must bring your student identification to the final exam. Information on content coverage, along with some sample questions will be posted on Quercus in advance.

Final exam conflicts (see http://www.artsci.utoronto.ca/current/exams/conflicts) and petitions for a deferred exam must be brought to the Faculty of Arts and Science, not your instructors.

Information on how to request a deferred exam due to illness or another valid reason is available at: http://www.artsci.utoronto.ca/current/petitions/common#deferred

Calculators

Students may find a non-programmable calculator to be useful for the final exam. Any basic calculator will be sufficient (no special functions are necessary). Calculators on phones or other devices equipped to communicate with the outside world (for example, through the internet or cellular or satellite phone networks) will not be permitted during the final exam.

Marking concerns with Assignments

Any requests to have an assignment re-graded must be made in writing directly to your instructors (Quercus message to STA288 "Teachers") **within one week** of the date the marks were posted on Quercus. To be considered, your message must clearly identify the question you have concerns about, contain a detailed justification for your concern and make specific references to your answer and to the relevant course material. Keep in mind that it is possible for your assignment grade to go down if the re-graded mark is lower than your original assignment grade.

Academic integrity

You are responsible for reviewing and understanding the content of the University of Toronto's Code of Behaviour on Academic Matters at http://www.governingcouncil.utoronto.ca/policies/behaveac.htm.

Academic offenses will be taken very seriously and dealt with accordingly. For all of the assessments in this course, submitting another student's answer(s) as your own, or providing your own answer(s) to another student for him/her to submit as his/her own is considered as an academic offense and will be reported as such. If you have any questions about what is or is not permitted in this course, please do not hesitate to contact any of the instructors in the course.

Intellectual Property Statement

Course material (i.e. lecture slides, assignment and midterm questions/solutions and other supplementary course material available on Quercus) is the intellectual property of your instructors and is made available to you for your personal use in this course. Sharing, posting, selling or using this material outside of your personal use in this course is **not** permitted under any circumstances and is considered an infringement of intellectual property rights.

No videotaping of lectures will be permitted under any circumstances. If you would like to make an audio recording of the lectures in this course, you MUST ask permission from your instructors in advance. According to intellectual property laws, not asking permission constitutes stealing.

Accessibility Needs

Students with diverse learning styles and needs are welcome in this course. In particular, if you have a disability/health consideration that may require accommodation, please feel free to contact Accessibility Services at (416) 978 8060; http://accessibility.utoronto.ca

How to Succeed in this Course

- Read this course syllabus in its entirety and understand the course policies.
- Attend and participate in class regularly and take notes (obtain notes from a classmate for any missed classes).
- Attend and participate in all labs and tutorials.
- Regularly review lecture notes and read the textbook and work through associated online resources such as the Learning Curve assessments available as a free resource.
- Do not try to memorize statistical concepts. Focus on understanding. If you find that you are having trouble with concepts please seek help as early as possible.
- Do not try to memorize the biological pathways – these are useful reminders and may help set the concepts for problems as well as help you remember related topics (i.e. provide context) for applications discussed in the course, but will not be tested separately – this is a statistics and scientific inquiry course.
- Complete assessments (i.e., labs and projects) carefully and as early as possible.
- Practice, practice, practice! Work through at least some of the recommended textbook exercises each week to make sure you understand the basic concepts. You need to work through practice problems frequently (not just right before the exam) to keep up in the course.
- Take advantage of the help available & ask questions (classes, tutorials & labs, office hours, Quercus Discussion Board).

Course Schedule

The tentative schedule for course topics is shown below. Some adjustments may be made to the weekly topics as the course progresses, depending on the rate at which individual topics are covered. The lab/tutorial schedule and due dates will remain unchanged though. Recommended textbook readings and problems will be posted on Quercus.

Week	Tentative topic schedule *(See Quercus for Information on Textbook Sections by Topic/Week)*	Dates	Class/Tutorial/Lab Schedule*	Due Dates
Jan 1-7		***No class this week***		
Jan 8-14	Introduction to the Course & Summarizing Data o Univariate o Multivariate	Tues, Jan 9	Class 11am - 1pm	
		Thurs, Jan 11	Class 11am - 1pm	
Jan 15-21	Summarizing Data (continued) & Sampling	Tues, Jan 16	Class 11am - 1pm	
		Thurs, Jan 18	**Section 1** - **Tutorial 1** 11am-1pm **Section 2** - **Lab 1** 11am-1pm (location on Quercus)	**Lab 1 assignment** (**Section 2**) due 6pm, Fri, Jan 19
Jan 22-28	Designing studies	Tues, Jan 23	Class 11am - 1pm	
		Thurs, Jan 25	**Section 1** - **Lab 1** 11am-1pm (location on Quercus) **Section 2** - **Tutorial 1** 11am-1pm	**Lab 1 assignment** (**Section 1**) due 6pm, Fri, Jan 26
Jan 29-Feb 4	Exploring behaviour of statistics across samples	Tues, Jan 30	Class 11am - 1pm	
		Thurs, Feb 1	**Section 1** - **Tutorial 2** 11am-1pm **Section 2** - **Lab 2** 11am-1pm (location on Quercus)	**Lab 2 assignment** (**Section 2**) due 6pm, Fri, Feb 2
Feb 5-11	Drawing conclusions about a population based on a sample - introduction to Statistical Inference	Tues, Feb 6	Class 11am - 1pm	
		Thurs, Feb 8	**Section 1** - **Lab 2** 11am-1pm (location on Quercus) **Section 2** - **Tutorial 2** 11am-1pm	**Lab 2 assignment** (**Section 1**) due 6pm, Fri, Feb 9
Feb 12-18	Making inferences about means	Tues, Feb 13	Class 11am - 1pm	
		Thurs, Feb 15	Class 11am - 1pm	**Project Proposal Due** – 6pm, Thurs, Feb 15 through Quercus

(Schedule continued on the next page)

Week	Tentative topic schedule *(See Quercus for Information on Textbook Sections by Topic/Week)*	Dates	Class/Tutorial/Lab Schedule*	Due Dates
Feb 19-25	---	*Reading Week – No classes*		
Feb 26-Mar 4	Comparing means using ANOVA	Tues, Feb 27	Class 11am - 1pm	
		Thurs, Mar 1	**Section 1** - **Tutorial 3** 11am-1pm **Section 2** - **Lab 3** 11am-1pm (location on Quercus)	**Lab 3 assignment** (**Section 2**) due 6pm, Fri, Mar 2
Mar 5-11	Comparing means using ANOVA (continued)	Tues, Mar 6	Class 11am - 1pm	
		Thurs, Mar 8	**Section 1** - **Lab 3** 11am-1pm (location on Quercus) **Section 2** - **Tutorial 3** 11am-1pm	**Lab 3 assignment** (**Section 1**) due 6pm, Fri, Mar 9
Mar 12-18	Exploring associations using Simple Linear Regression	Tues, Mar 13	Class 11am - 1pm	
		Thurs, Mar 15	**Section 1** - **Tutorial 4** 11am-1pm **Section 2** - **Lab 4** 11am-1pm (location on Quercus)	**Lab 4 assignment** (**Section 2**) due 6pm, Fri, Mar 16
Mar 19-25	Exploring associations using Simple Linear Regression (continued)	Tues, Mar 20	Class 11am - 1pm	
		Thurs, Mar 22	**Section 1** - **Lab 4** 11am-1pm (location on Quercus) **Section 2** - **Tutorial 4** 11am-1pm	**Lab 4 assignment** (**Section 1**) due 6pm, Fri, Mar 23
Mar 26-Apr1	Making inferences based on a categorical outcome	Tues, Mar 27	Class 11am - 1pm	
		Thurs, Mar 29	Class 11am - 1pm	
Apr 2-8	Review	Tues, Apr 3	Class 11am - 1pm	**Project Report Due** – 6pm, Wed, Apr 4 through Quercus
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*** All classes and tutorials are in WB 116.** Computing labs are held in multiple computer labs across campus – Your assigned Section (1 or 2) and lab location will be available on Quercus around Jan 15.