Laboratory Investigations in the Life Sciences

Biology 140 UBC Vancouver

Syllabus

BIOL 140 is a 2-credit, laboratory-only course that meeting for 11 or 12 weeks for 3 hours per session. It is offered in winter Term 1 and 2, as well as in Summer Session (although not in 2019) at UBC Vancouver.

GOALS OF BIOLOGY 140

Students will participate in the scientific process, emulating as closely as possible the fundamental steps research scientists follow. The main goals of this course are for the students to:

- participate in the **process of science** and demonstrate scientific thinking.
- acquire, organize, evaluate and integrate **information about a biological system**.
- practice **scientific skills** by: making observations, asking research questions, designing and implementing an experimental protocol appropriate for their questions, using lab equipment effectively and efficiently, recording and analyzing data.
- **communicate** orally and in a written form using the scientific explanation model and following format appropriate for biological journals.
- **work as part of a team** to design, perform and communicate the results of their experiment.

TEACHING APPROACH IN BIOL 140

In this lab-only course, students will practice thinking like scientists, which involves trying to answer questions for which there may be no clear answers. Attempting to answer interesting questions is the essence of biological science. Biology 140 instructors are trained to help students explore means of finding evidence to support or refute their predictions. They facilitate student learning by providing instructions for activities and guiding class discussions. The workbook instructions and questions as well as on-line materials further guide students through the scientific processes of observation, developing scientific questions, and designing an experiment. Working in research teams, students will develop communication and organizational skills. Team members are expected to contribute to the discovery and integration of observations, generated data, and published information. Effective team work enhances the generation of new scientific knowledge.

COURSE REQUIREMENTS AND RESOURCES

Academic requirements: all students in Biology 140 must have completed Grade 11 or 12 Biology, or BIOL 111.

Required text: the Biology 140 Workbook is required. Each week students will complete all exercises and answer the questions and completion of the work will be checked and stamped.

Lap top computers: may be required for in lab during various activities. At least one member in each research group will need to bring one to lab.

Recommended reference text: Freeman, S., Harrington, M. and Sharp, J. 2015. Biological science, 2nd Canadian Edition custom edition for UBC 2015-16 Pearson Education Inc., San Francisco, CA. This is the same text used for Biology 121 and can be a useful reference, but is not essential. Older editions are fine.

Biology 140 Canvas site: on the site are course materials, quizzes, announcements and other relevant information. Go to http://www.canvas.ubc.ca/ and use your CWL to login.

Piazza: this on-line site is intended for students to interact with peers. Students can ask questions, discuss their understanding of concepts and ask for clarification of ideas. Peers will respond with their suggestions. This site will be lightly monitored by one of the course Lab Faculty to ensure information is accurate.

Field Study: students will be required to collect data during a field study either at Tower Beach or in Pacific Spirit Regional Park.

The University has many resources available to help students:

UBC Wellness Centre https://students.ubc.ca/health-wellness/wellness-centre

UBC writing Centre https://students.ubc.ca/enrolment/better-grades/improve-writing

Science Advising https://science.ubc.ca/students/advising

Reach out: Help is available

https://thrive.ubc.ca/prevent-suicide/suicide-prevention-resources-and-training/

UBC Crisis support https://students.ubc.ca/health-wellness/crisis-support

EVALUATION

Biology 140 grades will be calculated as follows:

- Lab experiment: 45%
  - Research paper: Introduction section (individual, 12%)
    - Methods & Results section (group, 8%)
    - Discussion section (individual, 20%)
  - Oral presentation of experimental research (group, 5%)
- Field study: Informal lab meeting presentation (group) 5%
- Assignments: 13%
  - Five online quizzes (individual, total 5%)
  - Scientific Explanation assignment (individual, 6%)
  - Experiment Plan worksheet (group, 2%)
- Participation: 7%
  - Completion of each lab (5% total)
  - Peer evaluation of contribution (2%)
- Final exam 30%

ACADEMIC INTEGRITY

The academic enterprise is founded on honesty and integrity. As members of the academic community, all students are expected to know, understand, and follow the codes of conduct regarding academic integrity. At the most basic level, this means submitting only original work done by your and acknowledging all sources of information or ideas and attributing them to others as required. This also means you should not cheat, copy, or mislead others about what is your work. Violations of academic integrity (i.e., misconduct have serious consequences. For example, incidences of plagiarism or cheating may result in a mark of zero on the assignment or exam and more serious consequences may apply if the matter is referred to the President's Advisory Committee on Student Discipline.

A more detailed description of academic integrity, including the University's policies and procedures, may be found in the Academic Calendar at http://www.calendar.ubc.ca/Vancouver/index.cfm?tree=3,54,111,959

In BIOL 140 you will be conducting research and gathering information from the work of other authors and instructors. You must integrate this information and put these ideas into your own words when you submit written work for evaluation, and always cite the original source of the ideas. Submitting work that is copied from another student or written source is **plagiarism**. In this course we use Turnitin as a tool for you to use to avoid unintentional plagiarism. Refer to the information on Plagiarism and Turnitin in the Scientific Conventions section of the workbook.

BIOLOGY 140 COURSE SCHEDULE – Fall 2018

Lab no.	**Topics, activities and learning outcomes** * the schedule of activities may vary from year to year depending on the timing of low tides and when holidays occur.	
No labs	*First week of term students check in and buy workbook*	
Lab 1	**Investigations in Biology** 1. Questions in Biology 2. Scientific investigation scenarios activity 3. Investigating the effects of abiotic factors on intertidal organisms (Harley video) 4. Identifying common intertidal organisms 5. Your research animal/organism	**Learning Outcomes** • Distinguish between hypothesis-testing and discovery-based scientific investigations. • Use the concept of 'range of tolerance' to explain how variation in an abiotic factor can affect an organism's survival, reproduction and behaviour. • Use a simplified dichotomous key to identify marine organisms. • Use scientific nomenclature to name your research animal.
Lab 2	**Gathering and using data as scientific evidence** 1 Field sampling (Tower Beach/Bamfield) 2. Field notes and abiotic data to collect and record 3. Dealing with field data 4. Constructing a scientific explanation	• Use line-transect quadrat sampling to quantify the abundance (percent cover) of intertidal organisms. • Use instruments and tools to measure salinity, temperature and rugosity. • Use Excel to calculate and graph means and standard deviations. • Make a claim and justify it in the form of a 'Scientific Explanation' (using relevant evidence and articulating your reasoning).
Lab 3	**Intertidal field study at Tower Beach** 1. Collecting data 2. Discussion questions	• Measure the percent cover of intertidal organisms using line-transect quadrat sampling. • Identify potential abiotic factors that may influence the distribution, abundance and behaviour of your research organism.
Lab 4	**Lab meeting presentation and measuring animal behaviour** 1. Lab meeting presentations 2. Closer observations of your research species 3. Measuring behavioural responses of your research animal	• Describe the distribution and abundance of your experimental organism at Tower Beach. • Propose plausible explanations for data on abundance. • Establish and maintain different abiotic treatments in the lab. • Measure behavioural responses of your research animal and determine which is most effective.
Lab 5	*Thanksgiving Monday holiday* **Develop your research question** 1. Guidelines for working as a team 2. Dissecting a BIOL 140 Introduction	• Construct guidelines for effective group work. • Identify the content requirements for a BIOL 140 Introduction

	3. Finding and using scientific references 4. Developing your research question	• Identify and locate different sources of scientific information and distinguish among primary, secondary and tertiary literature. • Find information relevant to your research question within these sources. • Cite and reference information to credit the author(s) of the ideas and information you present using the proper format. • Develop a potential research question.
Lab 6	**Experiment Design** 1. Experimental design critique activity 2. Planning and designing your experiment 3. Preparation of your Introduction assignment	• Identify and describe fundamental elements of experimental design. • Identify flaws in experimental designs. • Explain the potential implications of a design flaw for the results and conclusions of an experiment. • Suggest changes to an experiment's design to correct flaws and to increase confidence in the results. • Describe advantages and disadvantages of minimizing biological variation in a sample of organisms. • Identify and describe design limitations in an experiment. • Design an experiment that tests the effect of a biologically relevant factor on an animal's behavioural response.
Lab 7	**Experimental Trial 1** 1. General procedure for experimental Trial 1 2. Evaluating Trial 1 3. Preparation for Trial 2	• Work as a team to rigorously implement a scientific protocol of your own design. • Carefully record quantitative and qualitative results from an experiment (measurements and observations) in a data table or spreadsheet.
Lab 8	**Experiment Trial 2** 1. General procedure for experiment Trial 2 2. Evaluating Trial 2 3. Preparation of Methods and Results	• Recognize and mitigate mistakes during the execution of an experiment • Modify/optimize experimental protocol based on experience and new information • Work efficiently as a team, to competently implement a scientific protocol • Make accurate and complete records of an experimental protocol and the associated results • Identify assumptions made when extrapolating results. • Describe difficulties in extrapolating results to animals in their natural habitat.

Lab 9	**Methods & Results, practice, and dissecting a Discussion** 1. Complete and finalize the Methods and Results Assignment 2. Practice preparing figures, describing data and answering questions on data analysis 3. Prepare to share your experimental findings (Oral discussion) 4. Dissecting a BIOL 140 written Discussion	• Prepare accurate and complete figures, including figure legends. • Clearly describe results obtained in simultaneous or separate treatment experiments.
Lab 10	*Remembrance Day holiday on Monday* **'Discussion' planning and development** 1. Dissecting a Biol 140 Discussion 2. Developing an outline for your discussion 3. Developing your Oral Discussion	• Use the 'Discussion instructions' and rubric to evaluate a sample Biology 140 Discussion • Use the scientific explanation format to write a plausible explanation for the variation in your data, potential inconsistencies between your group's findings and those findings reported in similar studies, and the reliability of your results; • Prepare an Oral Discussion.
Lab 11	**Oral discussion** 1. Oral discussion 2. Incorporating feedback into the outline for your written discussion	• Orally report the findings of your experiment on the effect of abiotic factors on animal behaviour • Relate your findings to the biological literature • Provide constructive feedback on other groups' experiments
Lab 12	**Scientific investigations in review** 1. Scientific Investigations in review 2. Research in a different context - **Beaty Museum** collections 3. Evaluation (course, instructor, peers) 4. Final exam information	• Articulate the process of scientific investigation and provide examples of each step. • Appraise the merits and identify limitations of laboratory and field studies. • Describe some of the resources available at the Beaty Biodiversity Museum. • Determine the appropriate context (field, lab, or museum) to investigate scientific research questions.
TBA	Day, time, and location of Final Exam to be announced by UBC on the SSC	

BIOLOGY 140 COURSE SCHEDULE – Winter 2018

Lab no.	**Topics and in-lab activities** * the schedule of activities may vary from year to year depending on when holidays occur.	
No labs	*First week of term students check in and buy workbook*	
Lab 1	**Investigations in Biology** 1. Questions in Biology 2. Investigating the effects of abiotic factors on terrestrial organisms (Alan Carol video) 3. Scientific investigation scenarios activity 4. Your research animal	**Learning Outcomes** • Distinguish between hypothesis-testing and discovery-based scientific investigations. • Use the concept of 'range of tolerance' to explain how variation in an abiotic factor can affect an organism's survival, reproduction and behaviour. • Use a simplified dichotomous key to identify organisms. • Use scientific nomenclature to name your research animal.
Lab 2	**Gathering information: Collections and further observations** 1. Observing diversity in collections – Beaty Museum 2. Measuring behavioural responses of your research animal 3. Constructing a scientific explanation	• Describe some of the resources available at the Beaty Biodiversity Museum. • Establish and maintain different abiotic treatments in the lab. • Measure behavioural responses of your research animal and determine which is most effective. • Make a claim and justify it in the form of a 'Scientific Explanation'.
Lab 3	**Develop your research question** 1. Guidelines for working as a team 2. Dissecting a BIOL 140 Introduction 3. Finding and using scientific references 4. Developing your research question	• Construct guidelines for effective group work. • Identify the content requirements for a BIOL 140 Introduction • Identify and locate different sources of scientific information and distinguish among primary, secondary and tertiary literature. • Find information relevant to your research question within these sources. • Cite and reference information to credit the author(s) of the ideas and information you present using the proper format. • Develop a potential research question.
Lab 4	**Experiment Design** 1. Experimental design critique activity 2. Planning and designing your experiment 3. Preparation of your Introduction assignment	• Identify and describe fundamental elements of experimental design. • Identify flaws in experimental designs. • Explain the potential implications of a design flaw for the results and conclusions of an experiment. • Suggest changes to an experiment's design to correct flaws and to increase confidence in the results.

		• Describe advantages and disadvantages of minimizing biological variation in a sample of organisms. • Identify and describe design limitations in an experiment. • Design an experiment that tests the effect of a biologically relevant factor on an animal's behavioural response.
Lab 5	**Experimental Trial 1** 1. General procedure for experimental Trial 1 2. Evaluating Trial 1 3. Preparation for Trial 2	• Work as a team to rigorously implement a scientific protocol of your own design. • Carefully record quantitative and qualitative results from an experiment (measurements and observations) in a data table or spreadsheet.
Lab 6	**Experiment Trial 2** 1. General procedure for experiment Trial 2 2. Evaluating Trial 2 3. Preparation of Methods and Results	• Recognize and mitigate mistakes during the execution of an experiment • Modify/optimize experimental protocol based on experience and new information • Work efficiently as a team, to competently implement a scientific protocol • Make accurate and complete records of an experimental protocol and the associated results • Identify assumptions made when extrapolating results. • Describe difficulties in extrapolating results to animals in their natural habitat.
Lab 7	**'Discussion' planning and development** 1. Dissecting a Biol 140 Discussion 2. Developing an outline for your discussion 3. Developing your Oral Discussion	• Use the 'Discussion instructions' and rubric to evaluate a sample Biology 140 Discussion • Use the scientific explanation format to write a plausible explanation for the variation in your data, potential inconsistencies between your group's findings and those findings reported in similar studies, and the reliability of your results; • Prepare an Oral Discussion.
Lab 8	**Oral discussion and introduction to a discovery-based investigation** 1. Oral discussion 2. Introduction to discovery-based research	• Orally report the findings of your experiment on the effect of abiotic factors on animal behaviour • Relate your findings to the biological literature • Provide constructive feedback on other groups' experiments
Lab 9	**Preparing for the forest field study** 1. Field sampling method 2. Identifying common plant species 3. Additional field observations and data 4. Dealing with the field data	• Use line-transect quadrat sampling to quantify the abundance (percent cover) of plant species. • Use a simplified dichotomous key to identify common plant species.

		• Use instruments and tools to measure light intensity and temperature. • Use Excel to calculate and graph means and standard deviations.
Lab 10	**Forest field study** 1. Sampling at Pacific Spirit Park 2. Questions to consider 3. Lab meeting presentation requirements	• Measure the percent cover of plant species using line-transect quadrat sampling. • Identify potential abiotic factors that may influence the distribution, abundance and behaviour of your research organism.
Lab 11	**Field study lab meeting and scientific investigations in review** 1. Lab meeting presentations 2. Scientific Investigations in review 3. Evaluation (course, instructor, peers) 4. Final exam information	• Describe the distribution and abundance of your research plant species. • Propose plausible explanations for data on abundance of your species. • Articulate the process of scientific investigation and provide examples of each step. • Appraise the merits and identify limitations of laboratory and field studies. • Determine the appropriate context (field, lab, or museum) to investigate scientific research questions.
TBA	Day, time, and location of Final Exam to be announced by UBC on the SSC	