Experimental design

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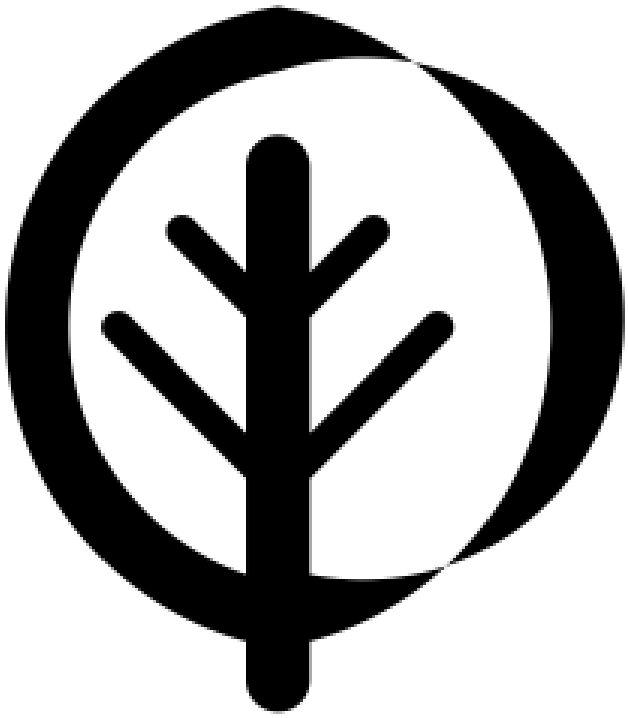
Contents

Introduction



Experiments shape the human experience. Experiments are a critical component of all living natural systems encompassing evolution to community dynamics. Experiments in science are creative, iterative, & source critical thinking. We naturally experiment in art, science, and life. Here, we hone these skills through principles and practice. The principles are here, and the practice is in the form a lab manual entitled Designcraft for experiments.

Course outline

If you are electing to engage with this learning opportunity formally, please see the official course outline for specific details. There are two summative assessments to the lecture principles (again pls see lab manual for work associated with the component of formal course offering).

1. Test (on content of the book and critical design thinking for science).

2. Grant proposal (for experiment and idea you care about).

Learning outcomes

1. Understand the core concepts of experimental design for any natural science experiment.

2. Understand key terminology, semantics, and experimental design philosophies.

3. Critically assess experiments.

4. Provide visual heuristics and workflows for experiments.

5. Be able to design & execute an effective experiment.

6. Be able to clearly write a well-structured manuscript suitable for publication in a journal.

7. Be able to write a competitive grant proposal appropriate for a Master's application.

Steps to design success

Module 1.

- Read a super book on experimental design.

- Take a test to demonstrate mastery of content and creative design for science experiments.

Module 2.

- Select a science topic that you care deeply about it and do research on this opportunity.

- Write a one-page grant proposal appropriate for a graduate-school funding application.

Rationale

Experiments are a powerful tool to understand, manage, and explore the world around us. This course will provide you with the terminology and concepts you need to be competitive and effective in research and employment. The lectures include exploration of the key terminology and ideas you need to process experiments. You will also practice design experiments in the labs.

Lectures/independent but facilitated student learning
Read. Think. Create.

In the first module (i.e., a total of 6 weeks allocated but please work at your own pace), we read a book together. This component of the lectures provides you with the critical elements, ideas, tools, and terminology you need to design better experiments. The extent that you develop your knowledge and design skills are evaluated using a test, provided in advance, that you complete on your own time. Lectures with decks are provided and they are the principles that emerged, for me, from reading the book.

In the second module (i.e., a total of 4 weeks blocked), you design an experiment for graduate-level research and prepare an NSERC grant proposal (very short, see guidelines). The primary purpose of this component of the lectures is to provide you with the opportunity to generate a novel, useful research proposal on a topic of your choice. Key readings and discussion are provided to support your development and exploration of a topic that further hone your skills.

Schedule

This is the recommended timing for completing work. Deadlines are firm for submission of summative assessments, but the pacing to get each of those points in time is up to you. In lectures (and labs), we will however work through and discussion the material in this order.

week	lecture
1	intro to course
2	textbook ch 1 & 2
3	textbook ch 3 & 4
4	textbook ch 5 & 6
5	textbook ch 7 & 8
6	textbook ch 9 & 10
7	**test**
8	[ten simple rules for awards](https://journals.plos.org/ploscompbiol/article?id=10.1371/journal.pcbi.10058
9	[ten simple rules for grants](https://journals.plos.org/ploscompbiol/article?id=10.1371/journal.pcbi.002001
10	shark-tank thinking for grants
11	finalize grant proposal, ensure effective experimental design & **see official course outline for due date**
12	grant thinking & discussion on best principles for experimental design applications in daily life

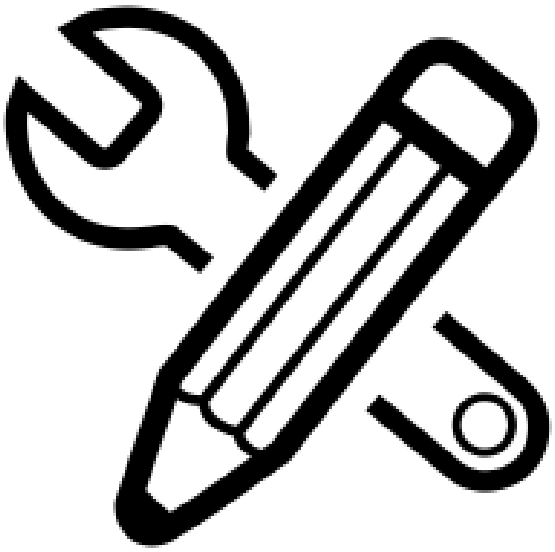
Citation

Lortie, CJ (2022): Biology for environmental management pocketguide. figshare. Book. https://doi.org/10.6084/m9.figshare.15031752.v3

License

Chapter 1

Principles



Learning outcomes

1. Explore one set of dimensions associated with a changing climate.
2. Link science for cities to your life.

3. Explore one tool that can enable replicable solutions.

Context

We experience weather but live with climate. Climate is complex. Climate change has both effects on us and is a response to many drivers including anthropenic processes. The reading provided examines urban effects specifically (McCarthy et al., 2010). Use the ten simple rules suggested to structure your analysis of this paper (Lortie and Owen, 2020). There is at least one solution that can enable better science. Replication and being able to test the same ideas again can be done using an open-source, and free, programming language to work with data, draw plots, and do statistics. R is one such tool, and it can be used to promote solutions for others to try with their challenges because the code can be shared (i.e. fondly recall math classes, show your work), and this documentation of science using data improves our solutions (Lortie, 2017).

Test questions

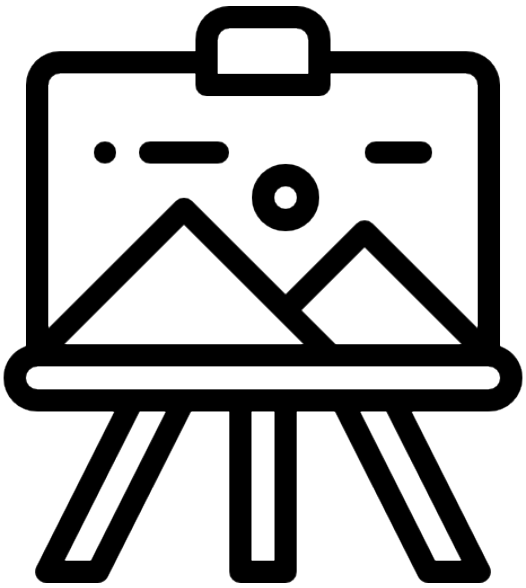
1.

Rubric

1.

Chapter 2

Grant



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Grant guidelines

1.

Rubric

1.

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McCarthy, M. P., Best, M. J., and Betts, R. A. (2010). Climate change in cities due to global warming and urban effects. *Geophysical Research Letters*, 37(9).