

Research Proposal

Part I: Topic and Literature

The goal of writing a research proposal is to put forth a scientific research question and then detail **how** you would go about answering that question. Most scientific research costs \$\$\$\$, so proposals are how scientists convince a funding agency to fund their research! This means you need to convince the funders that:

1. You have an interesting research question
2. You know how to answer the question (i.e., you have a good experimental/study design idea) and,
3. Knowing the answer would be informative/interesting to the scientific community or humanity at large!

Coming up with a topic/question

I know we have just started the course, so you may find it a bit tricky to come up with ideas. But don't worry! We are here to help you! And you are totally allowed to change your topic if the first one you submit isn't quite working out.

The only requirement for your research question is that it have *something* to do with evolution! Otherwise you can pick just about any system/critter/topic to propose for your research.

I have included some **helpful tips at the bottom of this page** to help you in picking a topic. If you are *totally*stuck on coming up with an idea, you can **choose one of the topics from the virtual labs linked below.**

Picked my topic, now what?

As you are figuring out your topic/question, start surfing the scientific literature for an article related to the topic you are interested in. You are looking for a **research article** from a **peer-reviewed scientific journal**. Please do NOT select a **review article**. ([Links to an external site.](#))[Links to an external site.](#)

You are looking for a paper that has asked a similar question to the one you want to propose in either the same or a different study system. Or you can find a paper that is on the same study system, but asks a slightly different question.

A good place to start looking for journal articles is the [Web of Science \(Links to an external site.\)](#)[Links to an external site.](#) or [google scholar \(Links to an external site.\)](#)[Links to an external site.](#). You can get access to many journal articles if you login to the UCSC library [VPN for off-campus access](#)

Helpful tips for picking a topic/question:

A good place to start is to think about a study system that you reeeeeeally like. Maybe you love...butterflies? Or birds? Or mice?!

(Side note: I know many of you will be drawn towards studying charismatic megafauna BUT, remember that it can be hard to study evolution in long-lived species... It's not impossible! But if you want to design an experiment, it is much much much easier to pick something that you can breed multiple generations in a lab).

Then ask yourself what makes your favorite critter/plant/system interesting to you? What kind of **variation** do you observe? (remember variation is the 1st requirement for natural selection to occur).

For example:

- Why do some butterfly species look like [leaves \(Links to an external site.\)Links to an external site.](#)?
- Why does this [bird \(Links to an external site.\)Links to an external site.](#) have such long feathers on its head?
- Why are these [mice \(Links to an external site.\)Links to an external site.](#) such different colors even though they are the same species?

Start thinking about what makes an organism cool/interesting, and then ask yourself if there is some aspect of evolution that may have shaped the pattern you observe (e.g. adaptations, natural selection, etc.). One really straight-forward question can be to ask if the variation you observe in a trait is due to natural selection (change occurs over many generations) OR phenotypic plasticity (change occurs during lifetime of individuals).

Virtual labs (aka a few more resources for ideas)

Here are a few virtual labs/games that may help give you some question/research ideas and might also give you some good ideas for how to set-up your study/experimental design later on during this proposal writing process.

Disclaimer: these virtual labs are all a *little* bit dorky but I promise they are helpful! They also all have links to the research/experiment that inspired the lab (helpful for finding that research article).

[Note: You are completely allowed to use any of these as your study system/research topic!](#)

- [Stickleback evolution lab \(Links to an external site.\)Links to an external site.](#): stickleback are a great model system for studying evolution because there is a lot of interesting trait variation depending on their habitat. Follow the link and click

"Enter virtual lab" and then check out "experiment 1" which will walk you through how to measure traits from fish collected from two different habitats

- [Anolis lizard lab \(Links to an external site.\)](#)[Links to an external site.](#): this is another really great study system. Again click "Enter Virtual Lab" and go to "Module 3: Experimental data" to see the experimental design these researchers used to look at evolution
- This [beach mouse simulation/game \(Links to an external site.\)](#)[Links to an external site.](#) was inspired by experiments/research done by the Hoekstra lab at Harvard. Think about how you could design an experiment to test if the color variation is adaptive for avoiding predators!
- And [this simulation \(Links to an external site.\)](#)[Links to an external site.](#) was modeled after research looking into the evolution of color vision (trichromatic vs dichromatic) in monkeys! Looky there, we CAN study charismatic megafauna!!

Part II: Research Proposal

The goal of a research proposal is to put forth a scientific research question and then detail **how** you would go about answering that question. Most research costs \$\$\$\$, so these proposals are how scientists convince a funding agency to fund their research! This means you need to convince someone that:

1. You have an interesting research question
2. You know how to answer the question (i.e., you have a good experimental design), and
3. Knowing the answer would be informative/interesting to the scientific community or humanity at large!

NOTE: The scientific papers that you have identified will come in VERY handy here in two ways:

1. **Use it as a template.** How did they organize their introduction? Their methods? What kinds of benefits did they describe in their conclusions? You are **not** copying what they wrote word-for-word (we all know that's a no-no)- but use their paper as a template to structure the flow of your ideas
2. Look at the papers they cited in their references and see if you find other interesting/inspirational research papers to help you develop an understanding of the background of your topic. Many of those papers will likely be useful to cite in your proposal.

Proposal Format:

2 pages max - letter size 12, 1.5 spaced

The proposal should be no more than two pages long (include page numbers) and should have a well thought-out title. It may contain diagrams or images **as appropriate** (images and literature cited **do not** count towards word count/ page limit).

Proposal should be divided into sections with the following sub-headers:

1. Introduction

Your introduction should be designed to interest your reader in your topic and proposal and provide some context for your project. At the end of your introduction, **include a hypothesis to clearly state your question or intention** (i.e., "In this project, I propose to..." or "This research project is designed to investigate ...").

Three templates to writing an Introduction:

- Template 1: Fact(s) about world \Rightarrow existing work explains poorly \Rightarrow we will explain it better.
- Template 2: This topic is heavily studied and important \Rightarrow but something is missing/wrong \Rightarrow and we will fix it.
- Template 3: Theories/facts seem contradictory \Rightarrow we support one side or resolve tension.

An introduction should convince your readers that what you propose to research is important and interesting. It should start from the general and move to the specifics, and it should make connections to ideas and previous research that have been recognized as important.

2. Proposed methods

The purpose of the proposed methods section is to provide enough information for the reader to:

- Understand how the design of the study addresses the research question or hypotheses
- Judge whether the methodology is appropriate

Think about your experimental design! A well designed experiment includes:

- **Independent (treatment) variables:** 1 or more likely causal variable that you manipulate. For each independent variable, there are 2 basic categories of treatment:
 - **Experimental group:** group that is subjected to the hypothesized causal factor
 - **Control group:** the group that has the "baseline" condition, so that you can compare to the experimental group, to assess the effect of treatment.
- **Potential confounding variables:** other variables that are held constant between groups.
- **Dependent (or outcome) variables:** appropriate measures of the treatment's effect
- **Replicates?** More replicates equal confidence and power. How do you know that the result you're seeing is not only by chance? Is it biased? You can have multiple test subjects within each of your experimental and control group (i.e. treatments) depending on your study. The number of replicates refers to the number of times you will repeat your treatments.

This would also be a good section to refer to other scientific literature as a template

Also in this section you can let the reader know what kind of patterns you would expect to confirm/refute your hypothesis:

e.g. "If we observed that shell thickness increased when the snails could smell the predators (but without actual predation), then we would conclude that there shell thickness is a plastic trait and snails can adjust thickness over their lifetime."

3. Conclusion.

In your conclusion, address the "So What?" of this research. That is, why does what you are investigating matter as more than an academic exercise? Why would this be helpful to the scientific community or to the non-scientific community?

For example, maybe your research question could tell us how a species would respond to climate change?...or what can happen to a community when a new species is introduced, or goes extinct? Think about BIG issues related to the environment or ecology, and explain how research in evolution could help us know a bit more about those other issues!

4. Works cited

You are required to cite **at least 4 sources** from the primary literature. This means you'll also need to have a works cited at the end of the proposal, with the citations in APA format. Any parenthetical citations in the text itself should also follow

APA guidelines. If you prefer another citation that is fine but make sure you are consistent!

Important note:

You will need to complete (and will also receive) TWO peer reviews for the first draft submissions. This means it is important that you need to hand your paper in by the due date, so that everyone can be assigned their peer reviews.

Common issues & helpful hints:

1. **You will NOT have results to discuss...** you'll only get to do the research if the reader decides to fund it! However, you should say what kind of evidence would confirm/refute your hypothesis (see example above).
2. Most common issue: your question is TOO BIG!
It's very difficult to write a research proposal on how dogs evolved to be man's best friend... It's *much much* easier to write a proposal examining if floppy ears in dogs is due to phenotypic plasticity or selection.
Take home message: Get SUPER specific- either with your question or your system.
3. You don't have to invent your own methods from scratch!
I strongly suggest that you look at a research article (not a review article) with a similar question. Then you can use their intro/methods as a **template** for your intro/methods. How did they set-up the question? What was their hypothesis? What methods did they use?
For example, maybe they looked at something related to founder effects in species A, and you want to ask the same question about species B.

Or, say you want to look at mtDNA to answer a question- you can cite a paper that has published methods on how to do it, and then describe how **you** would use those **same** methods (in your own words, of course!) for your research question. You don't have to come up with a brand new technique for sequencing mtDNA!
4. If you are confused about any of this, **you need to come office hours or set-up an appointment with one of us**. There should be no excuse for not understanding the assignment!