

UNIT 5. Developing Original DNA Barcoding Research Proposals

Overview: Our final unit is designed for students to generate their own questions that incorporate the science and techniques they have learned in the previous four units. We also provide examples of the kinds of questions that students have asked using DNA barcoding and how these questions can address local issues from mislabeling of fish to better manage fisheries to identifying populations of bed bugs in New York City.

1. *Searching the Scientific Literature:* Students can practice searching the scientific literature using Google Scholar. Google Scholar allows students to access articles that are available as a PDF. Practice literature searches help students determine the articles that are most relevant to their research interest. We developed an activity where students brainstorm some of their interests and then use a Google Scholar search to try and find related scientific papers (5.1a). Students are then encouraged to read the abstracts (and more if available) of multiple papers and begin to generate their own research questions (5.1b). From these activities, students can narrow down their interests to one question. From this question they can compile a series of articles to conduct their literature review.
2. *Reading the Scientific Literature:* After students generate researchable questions they can narrow their options down and find articles related to their specific subject. Reading scientific literature is challenging. In our curriculum we have supported student reading with the CREATE method developed by Dr. Sally Hoskins. We have adapted her work to meet the needs of high school students (5.2a). The CREATE method helps students break down the sections of a scientific paper so they can better understand the purpose and information in each section.
3. *Writing a Literature Review:* There are many guides that can help students write up a literature review. One we have found useful is [Dr. Roby's Completely Doable 10-Step Plan for Writing a Literature Review](#).
4. *Developing a Research Proposal:* We end the course with student's developing their own DNA barcoding research questions and writing up a research proposal. Included is the proposal description (5.4a), a proposal rubric (5.4b), and a proposal presentation rubric (5.4c).

5.1 a. SEARCHING FOR SCIENTIFIC ARTICLES

1. What are some general organisms that interest you?
2. What are some general topics (related to the class themes – environmental, molecular) that interest you?
3. What types of ecosystems interest you?
4. Create different combinations of search terms using your ideas from above. Write down 5 different sets of search terms below (Example: spiders and DNA barcoding and temperate forests).

5. Go into Google Scholar and search your terms from above. Find one article for each term that looks interesting and record the citation information (authors, title, journal, year, volume, issue, pages)

Example:

Search terms: Spiders and DNA barcoding and temperate forests

Citation: Rowan D.H Barrett, Paul D.N Hebert, **Identifying spiders through DNA barcodes**, *Canadian Journal of Zoology*, 2005, 83(3): 481-491.

1. **Search Terms** _____
Citation: _____

2. **Search Terms** _____
Citation: _____

3. **Search Terms** _____
Citation: _____

4. **Search Terms** _____
Citation: _____

5. **Search Terms** _____
Citation: _____

5.1b. GENERATING RESEARCH QUESTIONS

Read and scan the abstracts and articles, especially the introduction and conclusion to generate new research questions. Record five of your own questions.

For each question above answer the following:

1. What do you expect? What is your hypothesis?
2. Why does this study matter? Who cares?

Question 1: _____

Question 2: _____

Question 3: _____

Question 4: _____

Question 5: _____

5.2a. CREATE PROTOCOL

<i>C.R.E.A.T.E. Step</i>	<i>What am I doing?</i>	<i>I will learn to:</i>	<i>What goes in my CREATE Notebook</i>
C <i>Consider</i>	<ul style="list-style-type: none"> • Read the Introduction • Construct CONCEPT MAPS that identify the major concepts discussed in the introduction • Examine the relationships between the independent and dependent variables 	<ul style="list-style-type: none"> • Relate old and new knowledge • Define what I do and don't know about a topic • Review to fill gaps in my knowledge 	<ul style="list-style-type: none"> • CONCEPT MAP • 10 SENTENCES THAT SUMMARIZE INFORMATION FROM YOUR CONCEPT MAP • GLOSSARY OF RELEVANT VOCABULARY
R <i>Read</i>	<ul style="list-style-type: none"> • Read the Methods & Materials • DRAW CARTOONS that model the methods researchers used to collect their data 	<ul style="list-style-type: none"> • Visualize the experiments by representing "what went on in the field/laboratory" • Link specific methods to specific data • Describe <i>how</i> researchers generated the data 	<ul style="list-style-type: none"> • CARTOONS/DRAWINGS THAT ILLUSTRATE THE METHODS AND MATERIALS USED IN EACH EXPERIMENT
E <i>Elucidate hypotheses</i>	<ul style="list-style-type: none"> • Propose a testable hypothesis for each figure/table 	<ul style="list-style-type: none"> • Define, in my own words, the question being asked or hypothesis being tested in experiments related to each figure or table 	<ul style="list-style-type: none"> • HYPOTHESIS FOR EACH FIGURE/TABLE
A <i>Analyze and interpret the data</i>	<ul style="list-style-type: none"> • Read Results • Analyze data to identify what researchers actually found • Identify interesting findings or results • Predict which results researchers will focus on in the Discussion • Read Discussion/Conclusion • Identify important findings • Describe how researchers explain their results 	<ul style="list-style-type: none"> • Actively engage with data • Determine the significance of each figure • Determine the logic of each experiment • Define controls and determine their role • Relate data presented to results derived • Debate the significance of the data, defend my own ideas, and intelligently criticize the authors' interpretations 	<ul style="list-style-type: none"> • 10 FIGURE ANNOTATIONS FOR EACH FIGURE/TABLE • COMPLETED ANALYSIS TEMPLATES FOR EACH FIGURE/TABLE • BULLETED LIST OF 10 PREDICTED DISCUSSION POINTS • BULLETED LISTS OF ACTUAL DISCUSSION POINTS
T <i>Think of the next Experiment</i>	<ul style="list-style-type: none"> • Design an experiment or study that follows up on the current research • Cartoon the follow-up study's procedure for in-class discussion 	<ul style="list-style-type: none"> • Recognize research as a never-ending process • Exercise creativity in experimental design • Consider that multiple options exist; science is not necessarily linear and predictable 	<ul style="list-style-type: none"> • HYPOTHESIS FOR NEW EXPERIMENT • DESCRIPTION OF NEW EXPERIMENT • DRAW CARTOON OF METHODS

5.4a. DNA BARCODING PROPOSAL DESCRIPTION

For your final project, you will choose a DNA barcoding research topic that you will develop through the end of the semester based on your observations and questions. The first step is to develop a proposal for your research topic. Scientists develop proposals before they begin their research and to find funding for their projects. You will work in teams of 1-3 to write a proposal and prepare a presentation for the class.

IMPORTANT DATES:

Your proposal is due _____

Your presentation is due _____

Final presentation will be _____

PROPOSAL OUTLINE:

Your proposal should be typed, double-spaced, and should use the basic section outline and subheadings highlighted in **bold font** below:

KEYWORDS: List 3 -5 words that describe the topic of your research

TITLE: Use your keywords to clearly and concisely describe the content of your proposal

RESEARCH QUESTION(S): What question(s) are you trying to answer with your research?

HYPOTHESIS: What are your predictions for your research? Why do you expect this result?

INTRODUCTION

- a. Why is this research question important? Think Big Picture! What work has previously been done on this topic? Use facts, statistics, and primary literature references to back up your statements.
- b. Provide background information and literature to set a context for why you are choosing this project and why it is important to conduct your research project. Use information that relates to your project and helps to explain its importance including information about urban ecosystems, your organism(s), and DNA barcoding.

METHODS

- a. Provide details of how you will approach your study. Use the Urban Barcode Protocol as well as the literature to help you organize the sections of your proposal including (Study Site, Sample Collection, DNA Extraction, DNA Amplification, Sample Sequencing and Sequence Analysis.
- c. Remember that these methods might change between now and when you finish your project, but do the best you can with what you know now.
- d. Is there anyone that you need to contact in order to help you obtain samples? What organization/people are studying what you are interested in studying? Who are the primary researchers working on DNA barcoding of your organism? Where are they located? Where do they conduct their research?

STUDY PLAN (TIMELINE)

- a. Give a general plan for each month from June to January.

REFERENCES

- a. Find 5 to 8 primary literature references. Cite all references you have used in the proposal. Most of your references will come from the Introduction and Methods sections. Use APA citations for your references.

5.4b. DNA BARCODING PROPOSAL PAPER RUBRIC

Criteria	Points	Comments
Key Words: (5 points) <ul style="list-style-type: none"> Used words that are descriptive and informational 		
Title: (5 points) <ul style="list-style-type: none"> Clearly describes the nature of the study 		
Research Question: (10 points) <ul style="list-style-type: none"> Original question(s) that is clear and specific 		
Hypothesis: (10 points) <ul style="list-style-type: none"> Your expected results Why you expect these results 		
Introduction: (30 points) <ul style="list-style-type: none"> Provides sufficiently broad background info Provides rationale (Why is this important?) Provides a context (What has already been done?) Uses facts and statistics Citations within the text in proper format Goals and objectives of the study are clearly stated 		
Methodology: (25 points) <ul style="list-style-type: none"> Methods are directly aimed at testing the stated hypothesis Methods are feasible Identifies the data to be collected Identify the primary researchers and organizations Proposes using an unbiased, quantitative approach Procedures appear to be replicable 		
Timeline: (5 points) <ul style="list-style-type: none"> Research schedule identifies when all steps of the project will be completed 		
References: (10 points) <ul style="list-style-type: none"> Listed in scientific journal format (APA) Listed alphabetically Uses primary literature 		
Organization and Style: (20 points) <ul style="list-style-type: none"> Uses headings and subheadings to visually organize paper Few errors in spelling, punctuation and grammar All required elements are present and additional elements that add to the proposal (e.g., graphs, tables, figures) Proposal handed in on time 		
Total Points: (120 points)		

5.4c. DNA BARCODING PROPOSAL PRESENTATION RUBRIC

CATEGORY	4	3	2	1
Presentation Requirements	All required parts to the presentation are present including background, methods, proposed data collection, study plan, and references.	All but one of the required parts to the presentation is present, including background, methods, proposed data collection, study plan, and references.	All but two of the required parts to the presentation are present, including background, methods, proposed data collection, study plan, and references.	More than two parts of the required parts to the presentation are missing.
Research Question	Research question(s) is original, related to the topic and is very specific and clear.	Research question(s) is original, sort of related to the topic and is very specific and clear.	Research question(s) is original and related to the topic but is not specific or clear.	Research question(s) is not original, related to the topic and/or specific.
Hypothesis	Hypothesis is an “educated answer” to the research question based on observations and previous research that includes an explanation as to why you think that will happen.	Hypothesis is an “educated answer” to the research question but not based on observations or previous research that includes an explanation as to why you think that will happen.	Hypothesis is an “educated answer” to the research question based on observations and previous research but does not include an explanation as to why you think that will happen.	Hypothesis is an “educated answer” to the research question but not based on observations and previous research and does not include an explanation as to why you think that will happen.
Significance of Study	There is a significance and rationale to your study that clearly relates to your topic and is beneficial to society.	There is a significance and rationale to your study that indirectly relates to your topic but is beneficial to society	There is a significance and rationale to your study that relates to your topic but is not necessarily beneficial to society	There is no significance and rationale to your study that relates to your topic and it is not necessarily beneficial to society
Methods	Methods test your hypothesis, are clearly organized, original or based on previous research and repeatable.	Methods test your hypothesis, are not clearly organized but are original or based on previous research and repeatable.	Methods test your hypothesis, are clearly organized, but are not original or based on previous research or repeatable.	Methods do not test your hypothesis, but are clearly organized, original or based on previous research and repeatable.
Graphics and Animation	All graphics are relevant and contribute to the understanding of the topic and animations do not distract from the presentation.	Some graphics are relevant and contribute to the understanding of the topic and animations do not distract from the presentation.	Some graphics are relevant and contribute to the understanding of the topic and some animations distract from the presentation.	The graphics and/or animations are distracting throughout the entire presentation.
Slides	All slides are easy to read as a result of good backgrounds, text length, font size and font color.	Some slides are easy to read as a result of good backgrounds, text length, font size and font color.	Many slides are not easy to read as a result of poor use of backgrounds, text length, font size and/or font color.	Most slides are not easy to read as a result of poor use of backgrounds, text length, font size and/or font color.
Preparedness	Students are completely prepared and have obviously rehearsed.	Students seems pretty prepared but might have needed a couple more rehearsals.	The students are somewhat prepared, but it is clear that rehearsal was lacking.	Students do not seem at all prepared to present.
Volume	Volume is loud enough to be heard by all audience members throughout the presentation.	Volume is loud enough to be heard by all audience members at least 90% of the time.	Volume is loud enough to be heard by all audience members at least 80% of the time.	Volume often too soft to be heard by all audience members.
Speaks Clearly	Speaks clearly and distinctly all (100-95%) the time, and mispronounces no words.	Speaks clearly and distinctly all (100-95%) the time, but mispronounces one word.	Speaks clearly and distinctly most (94-85%) of the time. Mispronounces no more than one word.	Often mumbles or cannot be understood OR mispronounces more than one word.
Posture and Eye Contact	Stands up straight, looks relaxed and confident. Establishes eye contact with everyone in the room during the presentation.	Stands up straight and establishes eye contact with everyone in the room during the presentation.	Sometimes stands up straight and establishes eye contact	Slouches and/or does not look at people during the presentation.
Comprehension	Students are able to accurately answer all questions posed by classmates about the topic.	Students are able to accurately answer most questions posed by classmates about the topic.	Students are able to accurately answer a few questions posed by classmates about the topic.	Students are unable to accurately answer questions posed by classmates about the topic.

