

Enhancing Information Literacy in BIO 495 and other upper-level Biology Courses

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Project Motivation

All faculty in Biology and Marine Biology (BMB) at UNCW are expected to teach the BIO 495 Senior Seminar Course. The common learning outcomes for BIO 495 are that students will be able to: present biological information orally, critique biological literature, use primary literature to examine biological questions, and demonstrate competence in biological writing. BIO 495 also serves to meet the University requirement for Building Competencies/Information Literacy (IL), and thus aligns with the goals of ILFF. Additional courses taught within BMB, especially upper-level ones, include assignments or content related to the *Framework for Information Literacy for Higher Education*. For example, BIO 330 (Microbiology) has undergraduate students compare and contrast scientific research presented in news articles versus primary literature (Frames 1 & 2), and BIO 564 (Biological Oceanography) requires graduate students to delve deeply into the data presented in primary literature and assess the motivations, biases, and arguments (Frames 4 & 5). This ILFF project aims to further integrate and expand IL directly into a BIO 495 course focused on “Marine Microbiology and Science Communication” and explore how to intentionally add IL components to other upper-level Biology courses at UNCW (specifically, BIO 330 and BIO 564).

Project Objectives

- Incorporate IL-relevant reflections into BIO 495 activities and projects to cover all six frames over the course of the semester
- Use IL to train students, regardless of career path, on scientific literacy in order to improve public understanding of science and reduce distrust and misinformation.
- Intentionally expose graduate students to the IL framework
- Improve existing writing assignments to include reflection and assessment of IL concepts
- Share IL framework and exercises with other faculty in BMB to echo in their coursework

Progress

Below, I outline progress toward these objectives using four examples deployed or created during Spring 2023. Descriptions and excerpts from assignments are included when relevant.

1. Guided Literature Search Activity, BIO 495

As part of the final project for BIO 495, students are tasked with choosing a topic within Marine Microbiology that interests them and developing a presentation to share relevant information on the topic gained from primary literature and other scientific sources.

Alongside Science Librarian Peter Fritzler, we developed a series of questions to guide seniors enrolled in BIO 495 through their literature search for their research question. These questions cover most of the *Framework* (see below), and were shared as students began their search at the start of the semester. At midterm, feedback was given to them on any shortcomings in their assumptions or areas they had not fully explored or thought out. For the end of the semester, they were tasked with revising and resubmitting answers to each question to show development of IL skills. The assignment itself, including questions, is shared on the next page as developed by Peter Fritzler and myself during Spring 2023.

BIO 495: Marine Microbiology & Science Communication (Spring 2023)

Developed by: Peter Fritzler (Science Librarian) and Bradley Tolar (Asst. Professor)

The goal of this activity is to become familiar not only with some of the research on your topic, but to also develop a picture of the community involved in that research and its value to science and society. Working through the questions below will likely be an iterative process, meaning that the longer you engage in reading and discussing the research, the greater likelihood that you'll be able to answer these questions and develop a framework of how the science is produced and shared and valued within this community and beyond.

1. List important scientific and common keywords associated with your topic. **[Frames 4 & 6]**
2. Identify foundational, seminal, or key articles that have been published in your area(s) of study. List a few below and describe their significance. **[Frames 1 & 6]**
3. Discuss significant knowledge gaps in the science, debates, or controversies within your area of study. **[Frames 4 & 5]**
4. Scientific journals are the primary venue where scientists share the results of their research. However, scientists don't randomly select journals to publish their work; rather, they seek to publish their work in journals where their work is likely to be read and valued by others interested in the research. Identify the important journals that serve as outlets for publishing research in your area(s) of study. In other words, where are the "conversations" generally happening about research on your topic. List several below, particularly, those that are most important to the conversation. **[Frame 2 & 5]**
5. What are your views about open access (i.e., free to read) articles compared to paywalled articles published in scientific journals? Does publishing in either modality help or hinder the scientist(s) who authored the articles? Does publishing in either of these modalities help or hinder advancing or sharing the science with fellow scientists and non-scientist audiences? **[Frame 3]**
6. Begin thinking about scientists who are also doing work in your area(s) of study. List a few of their names and affiliations below. Are there scientists who have been significant contributors to the "conversation" about your topic? **[Frames 1 & 5]**
7. Scientific research, particularly in an academic and non-profit setting, is often fueled by grant funding from organizations. These organizations can be for-profit, non-profit or governmental groups. Identify several important organizations that fund research in your area(s) of study. **[Frames 1 & 3]**
8. Why is the research on your topic beneficial to science? Why is it beneficial to society? How would you describe research on your topic to a non-technical audience? How would you answer these two questions if asked by a scientist? What about a non-technical audience? **[Frames 2 & 3]**

2. Social Media and Communication to Broader Audiences, BIO 495

A topic in BIO 495 added intentionally to support IL was a discussion on Science Communication outside of academia, to non-experts and the public (“broader audiences”). Students were tasked with honing an elevator pitch on their own scientific and/or professional interests from 2 minutes to 1 minute to 30 seconds. This 30 second vetted, refined speech was then transformed into a social media, “Tik Tok” style video shared with the class and broadened to be impactful yet informative. This exercise is most closely tied to Frame 4: Information has Value, and led into a discussion of ways in which scientists communicating via social media could encourage development of IL in the public. Students were generally supportive of this idea, and as a group brainstormed actions that could be taken in this realm to improve public understanding of science and IL (alongside considerations related to Frame 1: Authority is Contextual).

This discussion continued into a session on Communicating to Broader Audiences, where we discussed (again related to Frames 1 and 4) best practices in sharing scientific information without oversimplifying. A useful tool was the 7 C’s of Science Communication developed from an [interview](#) with Dr. Vivienne Bryner (University of Otago, NZ):

(Risk) and Science Communication should be:

- **comprehensible** (i.e., simple, jargon-free, clear and concise),
- **contextualized** (i.e., acknowledges and reflects diversity of your audience),
- **captivating** (i.e., entertaining, engaging, salient, and relevant to everyday life),
- **credible** (i.e., open, does not overpromise, acknowledges uncertainty),
- **consistent** (i.e., backed by evidence, confirmable, coordinated and collaborated sources of information),
- **courteous** (i.e., compassionate, empathetic and respectful), and
- addresses **concerns** (i.e., empowers action and response, forms a dialogue)

Students were then tasked with summarizing a scientific article they had read to share with a classmate, and then given a “broader audience” to explain again in context (to push beyond limitations outlined in Frame 2 as intended audiences, and make any audience a viable one for scientific results). Example audiences included:

Program Manager at a Funding Agency	Private Donor
A Second Grader	A High School Student
Your Congressional Representative	Your Grandparent
Your Doctor	A Freshman Biology Major
Someone At the Grocery Store	Your Barista
Your Professor	A Scientist at a Conference
The UNCW Chancellor	A Journalist
An Influencer	An Environmental Policy Manager
A Climate Change Activist	Your Celebrity Crush
Your Future Child	A High School Teacher

This exercise was successful and will be deployed in future semesters of BIO 495, as well as incorporated into graduate-level training as part of an introductory course in Fall 2023.

3. IL-Centered Scientific Paper Summaries, BIO 564

An existing assignment in BIO 564 (Biological Oceanography) asks graduate students to select a primary literature article and summarize it to develop critical thinking and scientific writing skills. In Spring 2023, this assignment was modified to explicitly require assessment of the goals and purpose of the authors (Frame 2), outstanding questions about the topic (Frames 4 & 6), and any topics that the student could specifically add (Frame 5). An excerpt from the assignment itself is included below; these summaries led into weekly discussions in-class where students shared their ideas and critiqued papers read in preparation of class.

BIO 564 Scientific Paper Summaries

Spring 2023, Dr. Tolar

During this course, you will write and submit six summaries of scientific papers included within the BIO 564 Schedule and Readings List. This summary should be 1-2 pages and should contain all the necessary information for full credit (see detailed rubric below), including: the purpose of the study, a description of new knowledge gained, a summary of the methods, an evaluation of the conclusions, and your view of the paper overall in the context of the course and discussions.

Purpose: This assignment allows students to gain experience on how scientific research is presented to other scientists following the peer-review process. Through interpretation and summarization, students will gain skills in scientific communication and sharing microbiological concepts in written format. Finally, students will practice evaluating scientific writing and searching for primary literature online.

- Goals:**
- I. Choose six scientific journal articles over the course of the semester, taken from the overall reading list for class.
 - II. Read, interpret, and evaluate the journal article
 - III. Write a summary distilling the major points and how it connects to class

Instructions: Students will go through the assigned readings for the semester, choose six articles of interest to them, read and evaluate each article, and summarize them.

1. Over the course of the semester, select articles from the reading list that are of interest to you to summarize. It is suggested that you choose three before the midterm (March 2nd), and three before the final (May 4th). **All summaries should be submitted by May 10th.**
2. Once you have settled on your article of interest, read it thoroughly and take notes as you do (as you would for a normal class discussion). Use the following questions to guide your reading in preparation of crafting your summary:
 - a. **Interpretation:** What was the purpose of the author? How was data collected by the scientists? Was it presented adequately by the author? What were the conclusions of the paper presented in the news article?
 - b. **Connection:** How does this article relate to concepts discussed in class? What questions does it answer and/or generate for you?
 - c. **Evaluation:** How well was the article written? Does it effectively communicate the science? How do you feel about the article overall? Would you have written it any differently?

4. News-versus-Science Article Assignment, BIO 330

In preparation for the Fall 2023, a similar article summary assignment was refined for BIO 330. Since this course is for upper-level undergraduate students (juniors and seniors) who may still be developing IL and other skills related to assessing scientific literature, a component was previously added that had them first review and summarize news articles on microbiology research. To better connect differences in target audience (Frame 2), authority (Frame 1), and accessibility (Frame 3), it will be required that students select a news article based on a scientific finding published in a scientific journal, and summarize each in turn. First, students will find a news article that showcases a new discovery in microbiology and summarize the major points. They will then find and access the relevant primary literature publication the article was based on, and summarize the scientific article in their own words. Finally, they will be tasked with reflecting upon differences in the two types of scientific writing and intended audiences, and identifying gaps or miscommunicated findings. A reflection of this type was given in BIO 495 (Spring 2023) and included below as an example of the BIO 330 assignment:

BIO 495 – News Article Reflection

Spring 2023

After today's discussion on "Science in the News", revisit your submitted news article and find the associated scientific paper. Download it if you haven't already, and take some time to read and decipher it - use the annotated, printed copy of your news article from class to help your comparison!

Answer the following questions as a reflection on the two types of articles and how scientists and reporters might differently communicate the research:

1. What was the key takeaway of the news article? Did the headline match that takeaway?
2. What was the main conclusion of the scientific article? Did the news article's headline match what the scientific article's conclusion was?
3. Were there any important findings in the scientific article that the news article missed or skipped over? What reason(s) might the news article's author or editor thought to exclude that information?
4. Were there parts of the news article you understood better after reading the scientific paper? Or do you feel like the news article captured it all?
5. Do you know anything about the news source? What kind of an organization is it? (a newspaper/channel, a society, a blog?). Do you think this may have influenced the article's writing? Why or why not?
6. Were the graphics and/or illustrations included in the news article helpful? How do they compare to the figures in the scientific paper? Can you think of any figures that should have been included in one or the other?
7. If you were to write your own news summary based on the scientific paper, what would your headline be? What do you see as the main points, and do they agree with the news article you found?

As a final component of this comparison between a News Article based on a scientific paper, and the scientific article itself, BIO 495 students were tasked with reflecting upon their own summaries of both, considering what they added to the conversation (Frame 5) and the purpose, goal, and audience of each form of writing (Frame 2). This assignment prompt is included below:

BIO 495 – Scientific Article Reflection

Spring 2023

Now that you have finished your Scientific Paper Summary, go back to your initial News Article that you selected related to it, or the News Article Reflection. Submit here a short paragraph comparing your own summary of the scientific paper with the news article. How did you do? Do you think yours captured the same major points? Could your statements have improved the news article itself? And especially now that you have written your own Press Release, what are your feelings about the author of the News Article? Can you see why the journalist may have struggled (if you think they did)?

Project Conclusions

Through the ILFF Spring 2023 Program, the *Framework*, and helpful conversations with librarians and UNCW Distance Education and eLearning (DEeL), I was able to improve three of my new and existing courses (BIO 495, BIO 330, and BIO 564) and directly enhance IL concepts in biology courses. This complements both my personal and department-wide goals and stated student learning outcomes, and aligns with values on enhancing IL and scientific communication at all student levels in biology. These findings, example activities, and the *Framework* will be shared with the BMB faculty and incorporated into all future coursework taught by myself. An ultimate goal is to add the IL designation to the BIO 330 course, and incorporate the *Framework* more intentionally into graduate-level BMB coursework (even if IL designations are not yet given to 500- and 600-level courses at UNCW). In the near-term, the *Framework* and other IL concepts will be more directly incorporated into the BMB introductory graduate course (BIO 501, “Introduction to Science as a Profession”) that I will be co-teaching in the Fall 2023, alongside a specific module on Science Communication that I am developing (building upon my work on BIO 495).