Faculty Information Literacy Stipend
Final Report

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Introduction

Information literacy is paramount to the scientific endeavor. In Gene Editing Lab, students learn to design and perform CRISPR-Cas9 gene editing experiments. To better help students learn to search and read scientific literature, I designed information literacy assignments with outcomes that aligned with the following frames from the Framework for Information Literacy for Higher Education:

- **Information Creation as a Process**
  - Students will be able to articulate the capabilities and constraints of information developed through the various creation processes that will be explored.
  - Students will assess the fit between scientific articles, review articles, and opinion pieces and particular information needs.

- **Scholarship as Conversation**
  - Students will learn to identifying various types of information sources (review articles, opinion articles, and research articles).
  - Students will understand the various voices and perspectives that contribute to scholarship and develop familiarity with sources used to support or critique the ongoing conversation in their discipline (review articles and opinion articles).
  - Students will learn to identify different levels of authority within scientific journals.
  - Students will learn to recognize indicators of authority within scientific journals.

- **Searching as Strategic Exploration**
  - Students will be able to apply critical thinking to match appropriate search tools to their information needs.
  - Students will be able to identify the functionality of the following information tools: Pubmed, Web of Science, and Journal Citation Report.
  - Students will be able to refine their search strategies along the way, using different types of search language that would result in the most relevant results.

Description of the information literacy assignment or activities

Sylvia Jones gave a lecture on how to use the Web of Science and other databases to search for opinion pieces, review articles, and research articles and then rank them by using journal impact factors and the number of times that article was cited.

Each student was then asked to find and submit three different kinds of articles:

- Two *review articles* about the development of new CRISPR tools published within the last 5 years in journals with an impact factor of 8 or more.

- Two *opinion pieces* about the ethical concerns of CRISPR published within the last 5 years in journals with an impact factor of 6 or more.
- Three *research articles* about how CRISPR is being used as a therapeutic tool for human disease published within the last 5 years in journals with an impact factor of 8 or more.

At the beginning of the semester, students were broken up into groups of four. Each group was asked to present one of the scientific articles submitted by those in their group. Students were taught how research articles are structured and how to read them. For the presentation, each student presented a couple of figures and/or sections of the paper and required to meet with me to answer any questions on their respective parts.

Furthermore, to encourage everyone to read the research articles being presented and pay attention to the presentations, students were assigned interactive quizzes on the papers that were presented.

Method of assessment

The "Searching for and selecting review articles" assignment were assessed using the following rubric:

Searching for and selecting review articles				
Criteria	Ratings			Pts
Review article	3 pts Both papers	1.5 pts One paper	0 pts Neither paper	3 pts
Journal with an impactor factor of 8 or more	0.5 pts Both papers	0.25 pts One paper	0 pts Neither paper	0.5 pts
Recent (5 years or under)	0.5 pts Both papers	0.25 pts One paper	0 pts Neither paper	0.5 pts
On requested topic	1 pts Both papers	0.5 pts One paper	0 pts Neither paper	1 pts
				Total Points: 5

Figure 1. Rubric for "Searching for and selecting review articles" assignment

The "Searching for and selecting opinion articles" assignment were assessed using the following rubric:

Searching for and selecting opinion articles				
Criteria	Ratings			Pts
Opinion article	3 pts Both papers	1.5 pts One paper	0 pts Neither paper	3 pts
Journal with an impactor factor of 6 or more	0.5 pts Both papers	0.25 pts One paper	0 pts Neither paper	0.5 pts
Recent (5 years of under)	0.5 pts Both papers	0.25 pts One paper	0 pts Neither paper	0.5 pts
On requested topic	1 pts Both papers	0.5 pts One paper	0 pts Neither paper	1 pts
				Total Points: 5

Figure 2. Rubric for "Searching for and selecting opinion articles" assignment

The "Searching for and selecting research articles" assignment were assessed using the following rubric:

Searching for and selecting research articles					
Criteria	**Ratings**				**Pts**
Research article	3 pts All three papers	2.25 pts Two papers	1.5 pts One paper	0 pts No Marks	3 pts
Journal with an impactor factor of 8 or more	0.5 pts All three papers	0.38 pts Two papers	0.25 pts One paper	0 pts No Marks	0.5 pts
Recent (5 years or under)	0.5 pts All three papers	0.38 pts Two papers	0.25 pts One paper	0 pts No Marks	0.5 pts
On requested topic	1 pts All three papers	0.75 pts Two papers	0.5 pts One paper	0 pts No Marks	1 pts
					Total Points: 5

Figure 3. Rubric for "Searching for and selecting review articles" assignment

The presentations were assessed using the following rubric:

Journal Club rubric						
Criteria	**Ratings**					**Pts**
Student introduced/set up the figures presented	10 pts Excellent	8 pts Good	6 pts Satisfactory	4 pts Poor	0 pts None	10 pts
Student explained the experiments performed in the figures presented	10 pts Excellent	8 pts Good	6 pts Satisfactory	4 pts Poor	0 pts None	10 pts
Student demonstrated a good grasp of the experiments presented	10 pts Excellent	8 pts Good	6 pts Satisfactory	4 pts Poor	0 pts None	10 pts
Student explained the conclusions that can be drawn from the figures presented	10 pts Excellent	8 pts Good	6 pts Satisfactory	4 pts Poor	0 pts None	10 pts
						Total Points: 40

Figure 4. Rubric for presentations

Results and impact on student learning

Below is a violin plot showing student scores for each information literacy assignment. The percent scores on the y-axis were calculated using the rubrics shown in Figures 1-4 under *Method of Assessment*. The area of each violin is proportional to the number of data points and the dark diamond is the median. There were 12 students in the class.
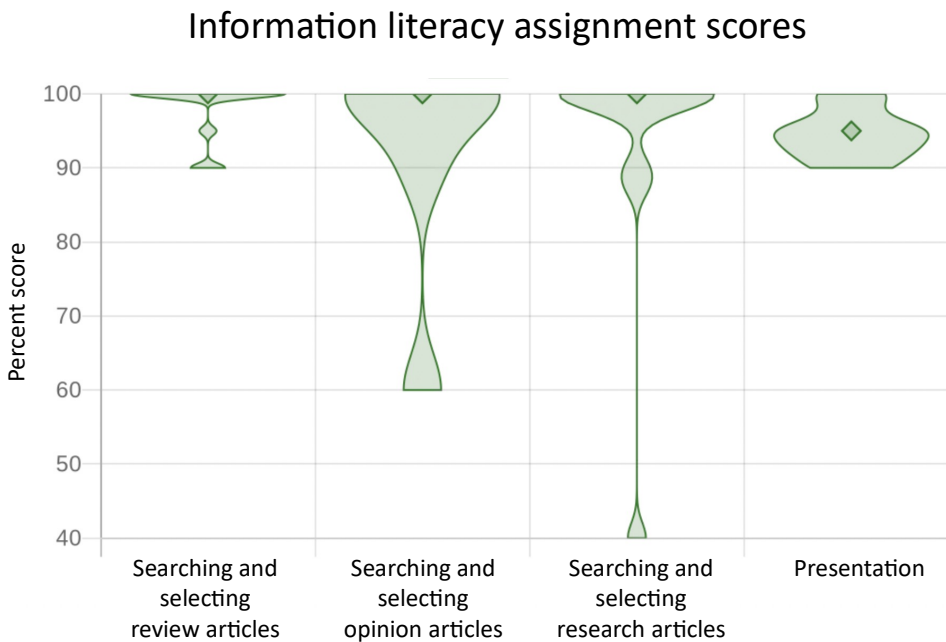
Information literacy assignment scores

Figure 5. Violin plot of information literacy assignment scores

In previous semesters, I had students search and select research articles and present on one of the articles chosen. Despite explaining to them the differences between research articles and other scientific articles (like opinion and review articles), many students submitted articles that were not research articles.

This semester, all but one student successfully found and submitted research articles. Additionally, most research articles submitted met the additional requested criteria: published less than 5 years ago in a journal with an impact factor of 8 or higher. I believe this is directly attributable to the following information literacy components that were added to the course this semester:

- the practical lecture given by Sylvia Jones on how to search for research articles and rank them by journal impact factor and citation number
- the assignments that required students to submit review articles and opinion articles before submitting research articles

Moreover, I was very pleased with the presentations given by the students. All the presentations were of high quality and level. As seen in the violin plot in Figure 5, students did a great job explaining their respective sections and/or figures from their assigned research article. I believe this is attributable to spending more time explaining the structure of a research article and how to go about reading a

research article, as well as requiring students to meet with me to answer any questions they had on their respective sections and/or figures before presenting.

Summary and next steps

The information literacy component that was developed for the Gene Editing Lab course was a success. Students learned how to search the scientific literature for research articles and review articles and rank them using journal impact factors and number of citations. Students learned how to read research articles, explain high-level experiments and data, and articulate how this data supported the conclusions drawn by the authors. These assignments added greater depth to the course and students left better equipped to engage with scientific literature.

Importantly, all of the outcomes that were linked to the three frames from the Framework for Information Literacy for Higher Education (Information Creation as a Process, Scholarship as Conversation, Searching as Strategic Exploration) were met.

Due to the success of this assignment sequence, I would most definitely implement it again in the future. Next time, however, I would start the assignment sequence earlier in the semester so that students have more time to read the research article assigned for them to present. I would also vary the rubrics for the three different "Search and select for […] articles" assignments more so that students can get more practice using different filters to find the requested articles.

Appendix (This includes the assignment sheet, rubric if used, and examle(s) of student work.)

Searching for and selecting review articles

Find **TWO review articles** using the guidelines below and **submit pdfs of the review articles by the due date below**. If both papers meet the criteria below, you will get full credit.

The papers should meet the following criteria:

- **review articles on the development or discovery of new CRISPR tools or systems** (base editing, prime editing, CRISPR systems from new species, or modified Cas enzymes)
- published in the last **3 years**
- from a scientific journal with an **impact factor of 20 or more** (e.g., Nature Reviews, Nature, Science, Cell, etc.)

To begin your search, use the **PubMed or Web of Science databases**. Type in the **keywords** for the article you wish to find and click **"Search"**. Once the results page pops up:

- move the slider under "**Results by year**" on the left to the desired time range
- click on "**Review**" under "**Article type**" on the left
- to determine whether the journal of the article of interest has an **impact factor** of 8 or more, use **Google** to search for the journal title followed by "impact factor." Alternatively, **type in the name** of one of the common reputable journals along with your keywords in the search bar.

Read "**A rough guide to picking a journal club paper** ↓ " for more information on how to search the scientific literature.

Figure 7. Prompt for the "Searching for and selecting review articles" assignment

Searching for and selecting opinion articles

Find **TWO opinion articles** using the guidelines below and **submit pdfs of the review articles by the due date below**. If both papers meet the criteria below, you will get full credit.

The papers should meet the following criteria:

- **two opinion articles on ethical concerns with CRISPR-Cas9, concerns of off-target effects with CRIPSR-Cas9, or limitations of CRISPR-Cas9**
- **recent** (under 5 years)
- **from a reputable scientific journal** with an **impact factor of 6** or more (e.g., Nature, Science, Cell, PNAS, PLOS, eLIFE, etc.)

To begin your search, use the **PubMed database**. Type in the **keywords** for the article you wish to find and click **"Search"**. Once the results page pops up:

- move the slider under "**Results by year**" on the left to the desired time range
- click on "**Editorial**" under "**Article type**" on the left. If "Editorial" does not appear on the list, click on "Additional filters" and then, under "Article type," click on "Editorial" and then click on "Show." Now click on "Editiorial" under "Article type" on the left.
- to determine whether the journal of the article of interest has the desired **impact factor**, use **Google** to search for the journal title followed by "impact factor." Alternatively, **type in the name** of one of the common reputable journals along with your keywords in the search bar.

Read "**A rough guide to picking a journal club paper**" for more information on how to search the scientific literature.

Figure 6. Prompt for the "Searching for and selecting opinion articles" assignment

Searching for and selecting research articles

Find **THREE research papers** using the guidelines below and **submit pdfs of the review articles by the due date below**. If all three papers meet the criteria below, you will get full credit.

The paper should meet the following criteria:

- **a research article** (not a review article or an opinion article) **addressing how CRISPR-Cas9 is being developed or employed as a therapeutic or diagnostic tool for human disease**.
- published in the last **2 years**
- from a scientific journal with an **impact factor of 8 or more** (in Nature, Science, Cell, PNAS, PLOS, eLIFE, etc.)

Suggested paper topics:

- using CRISPR-Cas9 to treat cancer, muscular dystrophy, cystic fibrosis, sickle cell anemia, HIV, or Alzheimer's
- using CRISPR-Cas9 to diagnose cancer, malaria, or COVID
- using CRISPR-Cas9 to reduce the transmission of malaria

To begin your search, use the **PubMed or Web of Science databases** ⤴, and use filters to **exclude Reviews and Editorials**. You can also use the review articles and opinion articles you selected previously and look for research papers cited in those articles.

For more information, refer to the "How to find an impactful research paper" document.

Then, from the research papers submitted by the members of your group, **I will select one paper for your group to present in Journal Club**. The paper I choose will be one I feel is the best balance between impactful, relevant, and accessible to beginners.

Figure 8. Prompt for the "Searching for and selecting research articles" assignment

Journal Club #2 (Nov 10th): CRISPR-Cas9 corrects Duchenne muscular dystrophy exon 44 deletion mutations in mice and human cells ✔ Published ⋮

This journal club will be presented in class. In the Journal Club materials module, there is a pdf of the paper as well as questions to guide you as you read the paper.

Those not presenting, please make sure to read the paper before we meet for journal club. You can use the journal club questions to guide you as you read the paper.

Below is the breakdown of who is responsible for what figure of this paper. The order was randomly generated, so there was minimal bias on assigning who is doing what. I am going to ask that you please meet with me before journal club to go over the section/figure you are in charge of and make sure you understand it.

Audrey Alasad	Intro: Duchenne Muscular Dystrophy, Dystrophin, existing therapies, hotspot mutations, exon 50 mutations and previous papers, exon 44 mutations
Callie Jacob	Figure 1:A-D. Background on iPSCs, exon skipping rationale
Kaegan Cowan	Figure 1:E-F. Background on Western blotting and immunofluorescence
Audrey Alasad	Figure 2:A-E. Background on RT-PCR.
Kaegan Cowan	Figure 2:F-J. Background on assays performed.
Luca Cocivera	Figure 3. Background on AAV9.
Callie Jacob	Figure 4
Luca Cocivera	Conclusion: recap/takeaways

Figure 9. Prompt for research article presentation from group 1

Journal Club #3 (Nov 17th): Genome-wide CRISPR Screens Reveal Host Factors Critical for SARS-CoV-2 Infection ✔ Published ⋮

This journal club will be presented in class. In the Journal Club materials module, there is a pdf of the paper as well as questions to guide you as you read the paper.

Those not presenting, please make sure to read the paper before we meet for journal club. You can use the journal club questions to guide you as you read the paper.

Below is the breakdown of who is responsible for what figure of this paper. The order was randomly generated, so there was minimal bias on assigning who is doing what. I am going to ask that you please meet with me before journal club to go over the section/figure you are in charge of and make sure you understand it.

Lindsey Philips	Intro: Coronaviruses, SARS-CoV-2, CoV life cycle, ACE2 receptors, why identify host factors required for infection, how does this paper accomplish this? Vero-E6 cell line pros and cons.
Liliann DeVos	Figure 1. Background on assays performed.
Amanda Benbow	Figure 2. Background on assays performed.
Giuliet Kibler	Figure 3. Background on assays performed.
Lindsey Philips	Figure 4. Background on assays performed.
Giuliet Kibler	Figure 5. Background on assays performed.
Liliann DeVos	Figure 6. Background on assays performed.
Amanda Benbow	Conclusion: recap/takeaways

Figure 10. Prompt for research article presentation from group 2

Journal Club #4 (Dec 1st): Precise correction of Duchenne muscular dystrophy ✔ Published ⋮

This journal club will be presented in class. In the Journal Club materials module, there is a pdf of the paper as well as questions to guide you as you read the paper.

Those not presenting, please make sure to read the paper before we meet for journal club. You can use the journal club questions to guide you as you read the paper.

Below is the breakdown of who is responsible for what figure of this paper. The order was randomly generated, so there was minimal bias on assigning who is doing what. I am going to ask that you please meet with me before journal club to go over the section/figure you are in charge of and make sure you understand it.

Brandon Flores	Intro: everything except base editing and prime editing
Hagan Ausmann	Intro: base editing and prime editing
Donny Duggan	Figure 1. Background on assays performed. Background on splicing and splice donor sites.
Imani Holmes	Figure 2. Background on assays performed.
Hagan Ausmann	Figure 3. Background on assays performed.
Donny Duggan	Figure 4. Background on assays performed.
Brandon Flores	Figure 5. Background on assays performed.
Imani Holmes	Conclusion: recap/take aways

Figure 11. Prompt for research article presentation from group 3