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# An Organic Chemistry Exercise in Information Literacy Using SciFinder

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Supporting Information

**ABSTRACT:** Working collaboratively, chemistry faculty members and librarians developed an exercise to introduce students in a large organic chemistry course to SciFinder and the chemical literature. Students learn fundamental concepts about the nature of the scientific literature through preclass readings, a preclass assignment, and an in-class discussion. Once students are familiar with several types of scientific literature (research articles, review articles, news articles) and peer review, they can more effectively search SciFinder to find scientific information. During class, students explore chemical data (including spectra) and learn to use SciFinder's natural language interface for searching the chemical literature. Assessment results demonstrated that students were learning about SciFinder for the first time and were impressed with the information available. Students were also successful at distinguishing between article types and recalling several methods of searching SciFinder.

**KEYWORDS:** *Second-Year Undergraduate, Organic Chemistry, Internet/Web-Based Learning, Enrichment/Review Materials*

As part of an effort to meet the American Chemical Society Committee on Professional Training (ACS CPT) guidelines for chemical information,[1] we have developed an exercise in information literacy. The guidelines say, in part, "A student...should know how to use the chemical literature effectively and efficiently. Instruction in chemical information skills must now acknowledge the dominance of online resources and provide access and instruction in those resources." Additionally, the faculty in our department strengthened the ties between librarians, chemistry students, and chemistry faculty.[2−4]

With this in mind, we have developed an exercise that has three main learning objectives.

(1) Students will demonstrate an understanding of the differences between three major types of chemical literature (primary research articles, review articles, and news stories), how each can be used, and the importance of the peer review process.
(2) Students will demonstrate the ability to use SciFinder to find chemical data.
(3) Students will demonstrate effective use of SciFinder to find literature on chemical topics.

To reach all of the chemistry, biochemistry, and prehealth majors in our department as well as biology majors, we incorporated information literacy instruction into our required sophomore organic chemistry laboratory course. This course meets in groups of 18 at a time, which allows for a greater amount of one-on-one interaction with the instructors. In addition to the small class size, the 4 h meeting time allows faculty to incorporate several information literacy concepts as well as hands-on practice.[4,5] Each year we are able to teach this exercise to nearly 500 students.

Prior to 2012, most published literature about SciFinder use in the classroom focused on small upper-level courses, largely as the result of limits on access to SciFinder ("seats"). Rosenstein[6] incorporated information literacy instruction into a sophomore-level organic chemistry lab but was only able to demonstrate SciFinder in class. Access limitations required students to use SciFinder to complete an assignment outside of lab time. In 2009, Schuetz described the incorporation of information literacy instruction into an organic chemistry lab but did not include SciFinder.[7] In the face of access restrictions, Dawson et al.[8] produced an online SciFinder exercise, which replaced a previously delivered demonstration-only lecture about SciFinder.

After Chemical Abstract Services rolled out its Academic Unlimited Access program in 2012,[9] librarians and chemistry faculty had additional options for incorporating SciFinder into chemistry classes and information literacy instruction. Ferrer-Vincent discussed the use of structured search exercises in teaching students to use SciFinder,[10,11] and several authors discuss the ability to incorporate SciFinder and information literacy instruction throughout a chemistry program.[2,3,12] Graham et al. were able to incorporate SciFinder as one of several options in a robust literature searching exercise.[13] Since the expansion of SciFinder access in 2012, many authors mention the use of SciFinder as an important part of a laboratory exercise but do not detail the training methods.[14−24] SciFinder or chemical literature instruction is also included as a component in introductory courses[25−27] or in upper-level undergraduate or graduate-level courses.[28,29]

Our exercise places increased emphasis on understanding the nature of the chemical literature. Tucci et al. recognize the importance of discussing these issues but do not provide detailed exercises.[2] With knowledge of the chemical literature, students understand the nature of the items they find through SciFinder.





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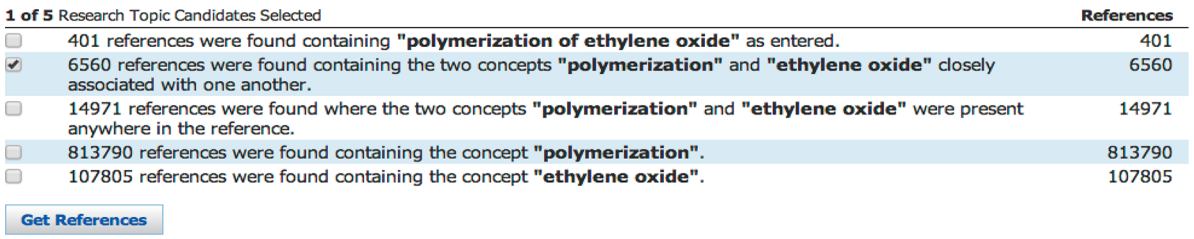


**Figure 1.** Using conjunctions to combine concepts in SciFinder allows users to select a set of references in which the two concepts are closely associated with one another. Users cannot select this set of references when using traditional Boolean operators (AND, OR). See Wagner[31] for a comprehensive overview of SciFinder's natural language interface.

## ■ PRIOR TO CLASS

Students register for SciFinder prior to class and are encouraged to bring their own laptop computers to class. Directions for the registration process are in their lab manuals and are a part of the preclass exercise, which is delivered via the learning management system on our campus. The preclass exercise also asks students to read a brief section in the lab manual about the nature of peer review and the scientific literature (Supporting Information). An abbreviated version of this reading is available on the author's website.[30] Students are then asked to locate three specific sample papers from the chemical literature (one primary research article, one review article, and one news story) and answer some questions about what they read. These questions include:

(1) Where are the authors of each paper employed? What do you think is their job (give your best educated guess)?
(2) Briefly describe how each article is organized.
(3) Whose studies and experiments are they writing about? Their own or someone else's?
(4) How might a chemist use each of these articles? Try to list two possible uses for each article.

In our class, we did not ask students to read the articles, merely to skim them in order to answer our questions about the nature of the item. Other lessons could easily incorporate discussions of the article content.

## ■ IN-CLASS EXERCISE

The in-class exercise has three main parts that focus on our three learning objectives: the nature of the chemical literature, finding chemical data, and finding chemical literature.

### Discussion of the Chemical Literature

Students are required to bring their preclass exercise answers to class for use during the in-class portion of the exercise. Students also hand in their work for assessment by the instructor. Librarians are responsible for delivering the "lecture" portion of the exercise. This fosters close collaboration between librarians and chemistry faculty.

Librarians facilitate a discussion about the three types of chemical literature and emphasize the differences between primary and secondary sources and the uses for each. During a typical discussion, students explore the differences between science journalists and academic authors, the differences between citation styles in scholarly and popular writing, and how to identify differences among various types of peer-reviewed journals. At some point in the discussion, the librarians ensure that the students understand the benefits and limitations of the peer review process. A complete guide to this discussion can be found in the Supporting Information. During the class discussion, the chemistry faculty have time to see who is participating, which holds students accountable for work done outside of class without the onerous grading requirements. After this discussion, we ask students to work in groups to summarize the discussion by identifying which factors are most useful for distinguishing between the different types of scientific literature examined in the preclass exercise. They record their answers on an in-class worksheet and then share them with the entire class. This allows librarians and faculty to double check for misconceptions.

### SciFinder Exercise

The next portion of the in-class exercise combines SciFinder search techniques with questions about the nature of the data. We ask students to retrieve the melting point for the compound famotidine. When students locate the data in SciFinder, they find several melting points listed. We then ask the students to consider why more than one melting point is listed, which connects lecture and lab content.

Once students have a better understanding of the types of chemical literature they can find within SciFinder, students examine SciFinder's natural language interface.[31] For example, students are asked to compare two searches: "polymerization of ethylene oxide" versus "polymerization and ethylene oxide".

Students are asked which of the two search statements would help them find the most relevant results and why that search statement was better than the other (see Figure 1). After a discussion of their answers with the class, an open-ended question is posed that requires the students to find one journal article (primary research article or review article) that contains an example of a Friedel−Crafts alkylation reaction, for example. This topic changes with the timing of the lab in order to link it to topics currently covered in the organic chemistry lecture. Students are asked to retrieve article metadata (title, author, year, etc.) and the specifics of the reaction.

## ■ ASSESSMENT

At the end of the period, student learning outcomes are assessed via a brief survey. Students must complete a survey to get the final answer for their worksheet, which involves finding the publisher of SciFinder (Chemical Abstracts Services), and ensures a high survey response rate. A Google form allows us to collect data across all lab sections. Students are asked to examine a journal article and determine the article type and to explain their reasoning. Students are also asked to list the ways in which SciFinder can be searched for chemical substance information and to identify (from a list of options) the search statement that will return the most relevant results. We also ask students what new material they learned and of what they were already aware.

We found that after one session, 83−89% of students (depending on the semester) were able to correctly identify the


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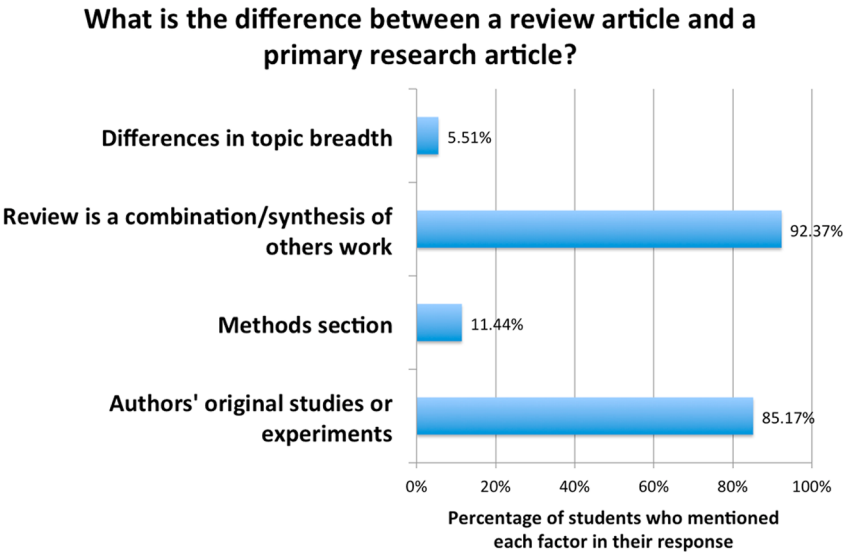


**Figure 2.** When asked the difference between a primary research article and a review article, most students pinpointed the primary differences: the origin of the studies discussed in the article.

given article as a primary research article. Analysis of their explanations indicates that students generally understood that primary research articles describe the results of original experiments or studies performed by the authors of the paper (see Figure 2).

Of the three ways to search SciFinder that were discussed in class, students usually are able to correctly state at least two of them. Students were most likely to forget the chemical structure capabilities of SciFinder. Students did not practice this search strategy because technical issues make simultaneous structure searching difficult. Twenty-six percent of students mentioned that they learned about some aspect of search strategy, that is, about natural language searching, applying filters, etc.

As expected, some students felt they were already familiar with the different types of scientific literature. However, very few students had previously used SciFinder. The content available via SciFinder and the search strategies used were new for almost all students.

Some typical student comments from this assessment include:

- I never knew that there was a way to find basic chemical properties and then click a link that will take you to the original work in which that information was published.
- Scifinder is way more specific than Google.
- "And" and "of" will lead to different results.
- I learned the clear difference between a primary research article and a review article and short-cuts that help differentiate the two.
- "A primary research article discusses the authors' original research and offers analysis of the results. A review article reports outlines the current state of research in a particular field by citing literature and connecting the various sources together."

Assessment results and student comments have helped librarians and faculty clarify confusing concepts and improve their presentation of material during the session. For example, during the discussion of article types, the librarian now draws a table on the whiteboard to help students more easily compare and contrast the three types of resources.

## ADDITIONAL INSTRUCTION IN UPPER-LEVEL CLASSES

Chemistry students will use SciFinder again in upper-level classes, at which point additional features of the database are discussed including structure searching and cited reference searching. At that time, students are also introduced to additional information resources and topics related to the chemical literature.

## CONCLUSION

The organic chemistry laboratory has been an effective course for SciFinder and information literacy instruction. We are able to reach almost all biology and chemistry majors, while the connection between chemistry faculty and librarians is strengthened. Students learn about the types of information available in SciFinder (chemical data and scientific literature) and the strategies useful for finding that information. Faculty teaching upper-level classes are happy to see students turning to SciFinder as the first source for finding scholarly literature.

## ASSOCIATED CONTENT

### Supporting Information

Preclass assignment and reading, in-class exercise, final assessment questions, and extensive notes for instructors regarding the in-class discussion of the types of literature. This material is available via the Internet at http://pubs.acs.org.

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### Notes

The authors declare no competing financial interest.

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