Integration of EndNote Online in Information Literacy Instruction Designed for Small and Large Chemistry Courses

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ABSTRACT: The blended model for information literacy instruction described in this article introduces students not only to efficient techniques for finding scientific literature and properties of chemical compounds, but also to managing this information with a bibliographic management program (EndNote Online). The model blends face-to-face instruction with online tutorials posted on a LibGuide page prepared for each course. A graded online assignment designed in SurveyMonkey was used to assess student learning. During the instruction, students learned to find literature in Google Scholar, PubMed, Scopus, SciFinder, and Web of Science. They also searched for properties of chemical compounds in ChemSpider, PubChem, Reaxys, and SciFinder using a chemical name, molecular formula, CAS Registry Number, or by drawing a molecular structure. The results from the assignments showed that students learned how to find literature and chemical property information efficiently and use a bibliographic management program to store, organize, share, and cite references. This article presents the implementation of the model in two small (40–60 students) and one large (380–460 students) undergraduate chemistry courses. The information literacy instruction described in this article was carried out in more than 20 undergraduate and graduate courses at the University of Maryland College Park. It provided more than 5000 students with versatile skills that they can use throughout their college education and even later in their professional life. The design of the model and its implementation was a result of a close collaboration between the chemistry librarian and the course instructors.

KEYWORDS: First-Year Undergraduate/General, Second-Year Undergraduate, Upper-Division Undergraduate, Cheminformatics, Curriculum, Computer-Based Learning, Hands-On Learning/Manipulatives, Internet/Web-Based Learning

INTRODUCTION

With science becoming more interdisciplinary and complex and the volume of publications growing so quickly, it is becoming increasingly difficult for students and researchers to find and manage scientific information efficiently. Management of scientific information includes how students and researchers perform a search, narrow down results, export references to a bibliographic management program, and insert citations in a Word document. Teaching students how to find chemical information and manage scientific literature more efficiently could help them use such transferable skills not only in a particular course but throughout their college education and later in their professional life.

Information literacy instruction has been a major responsibility of chemistry librarians for decades and many articles describe how such programs were introduced in the chemistry curriculum. Two recent books, “Chemical Information for Chemists: A Primer” and “The Future of the History of Chemical Information” include chapters written by experts in chemical information who share their vision of the field and its future. They also provide practical information, which can be very useful to anyone who teaches chemical information or wants to learn more about the chemistry resources.

A new book, “Managing Scientific Information and Research Data,”11 by one of the authors of this article looks at science information literacy from a broader perspective and in the context of the new technologies and the higher expectations from education. It discusses the new roles that academic librarians could play in supporting education and research in their institutions and how the new areas of eScience, data literacy, data management, and Electronic Laboratory Notebooks (ELNs) can become essential elements of information literacy instruction in the future.

Students are often uncertain which resources they should use to find scientific information. During the instruction, students should be provided with information and comparisons of the resources covered in class, so that they can choose the most suitable one. Many resources now are integrated on platforms that allow searching two or more specialized databases at the same time from one access point.

Chemical information instruction conducted in undergraduate courses usually involves educating students about

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the general library resources and how to find scientific literature and chemical property information. College students, though, have to write papers and cite literature, which requires using a bibliographic management program to do it efficiently. While the libraries offer workshops on such tools, these events are detached from the curriculum and rarely attract undergraduate students. Bibliographic management programs are sometimes mentioned during library instruction sessions, but this is not enough for students to learn how to use them in practice. There are almost no reports in the literature on incorporating a bibliographic management program as part of chemical information instruction. One article described the incorporation of the reference management program Zotero into a chemical literature course for the purpose of developing proper citation habits in students.15

In the past few years, new models of instruction such as flipped and blended formats have been adopted by instructors.16 The model presented in this article uses a blended format that includes both a face-to-face instruction and online materials and resources. Its main concept is based on the understanding that students need to be introduced to strategies and tools that will allow them to not only find and filter scientific information but also organize and manage this information more efficiently. This article presents results from the implementation of the model in two small (50–60 students) and one large (380–460 students) undergraduate chemistry courses. The close collaboration between a librarian and course instructors was essential for the success of this model.

■ GENERAL DESIGN

In this model, a bibliographic management program (EndNote Online) is positioned as a central component of the information literacy instruction. Students learn how to use the basic features of this tool in “real life” situations. They perform searches in the literature databases, filter results to make them more manageable, export citations to their EndNote libraries, organize references in groups, create bibliographies, and insert citations in papers they are writing. Finding properties of chemical compounds by using a chemical name, molecular formula, CAS Registry Number, or by drawing a structure is another integral area covered by the instruction. The model was developed and implemented in more than 20 undergraduate and four graduate courses, as well as in honors and Professional Writing Program courses. The number of students in all courses where this model was implemented was more than 5000.

Assessment of student learning and obtaining feedback from students are important components of an instruction,17–19 as they help improve the instruction design. Since most of the students were using the resources for the first time, it was important to allow them to practice the new skills through an online assignment, in which the questions included detailed instructions. The level of sophistication of the instruction and the assignment was the same for the three courses, because the students in these courses had not received information literacy instruction before. The questions on the assignment were tailored to the specific course.

The objectives for the instruction model reported and the skills that students were expected to learn are outlined in Boxes 1 and 2, respectively.

Box 1. Objectives for the Information Literacy Instruction Model

- Design a model for information literacy instruction that reflects student needs, satisfies the educational requirements of the discipline, and can be adapted to different courses.
- Gradually implement the model in courses at all levels.
- Generate interest and enthusiasm in students for learning and using the science resources.
- Assess student learning and feedback and modify the model, as needed.
- Aim at improving student overall standing and retention.

Box 2. Skills That Students Learned from the Instruction

- Collect, organize, share, and manage citations with a bibliographic management tool.
- Find, filter, and manage scientific literature.
- Compare resources and select the best option for finding literature.
- Insert citations in Word documents.
- Distinguish scientific documents (research paper vs review article).

■ ELEMENTS OF THE BLENDED INFORMATION LITERACY MODEL

The blended information literacy instruction model includes face-to-face instruction sessions, online resources, and assessment of student learning. Before coming to class, students had to create accounts for SciFinder and EndNote Online.

Face-to-Face Instruction Sessions

The face-to-face instruction was performed during regular lab periods for 50 min. The sessions for the small courses (CHEM 277 and CHEM 425) were conducted by the librarian (Svetla Baykoucheva), while the sessions for the individual sections of the large course (CHEM 272) were taught by TAs who were trained by her.

Online Components

LibGuide. A LibGuide20 was used for the instruction to provide access to resources, handouts and other instructional materials, as well as to the online assignment. Individual LibGuide pages were created for each course and can be viewed under the tab “Course materials”. The LibGuide course pages and the instructional materials were updated for each semester.

Handouts: Handouts were created for each course to provide detailed instructions on how to use the resources. They were also very helpful to students when doing the assignments because they were based on specific examples relevant to the course and preselected by the instructor. A sample handout is included in the Supporting Information.

Online tutorials helped students understand how to use the resources.

Online assignments are discussed under Assessment of Student Learning. Examples of assignment questions are included on pp 3–12 in the Supporting Information.

Assessment of Student Learning

The assessment of student learning and evaluation of the feedback from students are important parts of the instruction design. Students had to complete an online assignment in SurveyMonkey. A link to the assignment was provided on the
course LibGuide page. The results from the assignments were exported to Excel spreadsheets and were analyzed on an individual and group level. The assignment was graded and the grade was included in the total grade of the student for the course.

The assignments included questions related to general search strategies, features of EndNote, and specific questions that required students to search the databases and find the correct answers. The questions fall into the following main categories:

- General questions (the differences between a research article and a review; basic principles for narrowing down search results; using wild cards (for example, an asterisk))
- Basic features of EndNote Online
- Finding and filtering literature
- Finding property information using a chemical name, CAS Registry Number, or drawing a molecular structure.

Some of the questions required finding information in one database and using it to search for other information in another database. Other questions allowed students to apply skills for searching the databases and using EndNote.

The instruction and the assignment also included elements that were specific to the course and the needs of students in preparing reports and doing lab work. Examples of the questions used in the online assignments are included in the Supporting Information. The main goals of the assignment are presented in Box 3.

### Box 3. Assignment Goals

Train students, step-by-step, to perform complex searches for finding literature and property information in different databases, and practice the strategies they were shown in class at their own pace.

Assess student learning outcomes (assignment grades were included in the final course grades of the students).

Assess students’ ability to successfully follow complex instructions and force them to perform the searches.

Obtain feedback from students about the instruction, the assignment, the instruction format, and the usefulness of the resources.

Assess students’ skills for using a bibliographic management program (EndNote Online).

### Resources Covered in the Instruction

The resources included in the instruction (shown in Box 4) were the most important science databases that allowed finding literature and property information. They included both free (Google Scholar, PubChem, PubMed, and ChemSpider) and subscription-based databases (Merck Index Online, Reaxys, SciFinder, Scopus, and Web of Science).

**EndNote Online** (www.myendnoteweb.com) was used as an example of a bibliographic management program, but other similar tools (e.g., Mendeley, Papers, RefWorks, Zotero, and Readcube) were also mentioned during the instruction. More detailed evaluation and comparison of these programs is available elsewhere. The training on EndNote allowed students to quickly learn how to use the program. After getting familiar with its basic features, students performed searches in each of the databases, narrowed down results by different criteria and categories, and exported selected references to their EndNote libraries.

### Box 4. Resources Covered in the Instruction

**EndNote Online** (Bibliographic management tool)

**Literature databases:**
- Google Scholar (free)
- PubMed (free)
- SciFinder (paid subscription)
- Scopus (paid subscription)
- Web of Science (paid subscription)

**Chemical property databases:**
- ChemSpider (free)
- PubChem (free)
- Reaxys (paid subscription)
- SciFinder (paid subscription)
- Merck Index Online (paid subscription)

**PubMed** (www.ncbi.nlm.nih.gov/pubmed) (from the U.S. National Library of Medicine of the National Institutes of Health) is a free biomedical resource. It is based on the MEDLINE database. Students had to do a search using the advanced (MeSH indexing) features of PubMed, to find only articles that were specifically devoted to the topic they were searching literature for.

**Reaxys** (www.reaxys.com) (from Elsevier) is a large database that incorporates several databases for chemical property information, as well as a patent database. It provides significantly more information on properties of chemical compounds than PubChem and ChemSpider, as it combines several large chemistry databases. While SciFinder also has these capabilities, structure searching has been demonstrated to students only in Reaxys.

**SciFinder** (www.cas.org/products/scifinder) allows searching for literature, patents, dissertations, conference proceedings, and properties of chemical compounds. It searches simultaneously two large literature databases (the Chemical Abstracts database (CAplus) and MEDLINE). It also provides access to the Registry File, the largest chemical substance database with property information.

**Scopus** (www.scopus.com) (Elsevier) is a very large database that was introduced in this model in the fall semester of 2014.

**Web of Science** (http://webofknowledge.com/WOS) (Thomson Reuters) is a large interdisciplinary database. It is based on the Science Citation Index and is currently part of Web of Knowledge. This database has been used in all courses and during all semesters. Exporting references from Web of Science to EndNote is very easy, because these resources are provided by the same vendor and work well together. Narrowing down results by publication year was emphasized for Web of Science, because, by default, the years are arranged by the number of documents published each year, rather than chronologically. To have the years arranged chronologically, users have to select the “Alphabetical” option.

Details about features of the databases covered in the instruction are included on pp 1–2 in the Supporting Information.

### IMPLEMENTATION OF THE MODEL

In this paper, we describe the implementation of the information literacy instruction model in three chemistry undergraduate courses: CHEM 272, CHEM 277, and CHEM 425 (Table 1). Table 2 shows the sequence of laboratory chemistry courses at the University of Maryland College Park.
Table 1. List of Courses Discussed in the Article

<table>
<thead>
<tr>
<th>Course</th>
<th>Course Size</th>
<th>Semesters</th>
<th>Sections</th>
<th>Students</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHEM 272(^a)</td>
<td>380–460</td>
<td>3</td>
<td>20–22</td>
<td>1,379</td>
</tr>
<tr>
<td>CHEM 277(^b)</td>
<td>40–50</td>
<td>7</td>
<td>2</td>
<td>329</td>
</tr>
<tr>
<td>CHEM 425(^c)</td>
<td>50</td>
<td>10</td>
<td>5</td>
<td>500</td>
</tr>
<tr>
<td>All students</td>
<td></td>
<td></td>
<td></td>
<td>2,750</td>
</tr>
</tbody>
</table>

\(^a\)General Bioanalytical Chemistry Laboratory (for nonmajors).
\(^b\)Fundamentals of Analytical and Bioanalytical Chemistry Laboratory (chemistry and biochemistry majors).
\(^c\)Instrumental Methods of Analysis.

Table 2. Sequence of Laboratory Chemistry Courses at the University of Maryland College Park

<table>
<thead>
<tr>
<th>Course Number (nonmajors/ majors)</th>
<th>Course Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHEM 132/177</td>
<td>General Chemistry Laboratory I</td>
</tr>
<tr>
<td>CHEM 232/237</td>
<td>Organic Chemistry Laboratory I</td>
</tr>
<tr>
<td>CHEM 242/247</td>
<td>Organic Chemistry Laboratory II</td>
</tr>
<tr>
<td>CHEM 272/277(^d)</td>
<td>General Bioanalytical Chemistry Laboratory</td>
</tr>
<tr>
<td>CHEM 425(^e)</td>
<td>Instrumental Methods</td>
</tr>
</tbody>
</table>

\(^d\)Courses discussed in this paper.

CHEM 272/277 are General Chemistry II Laboratories offered in the fourth semester of the introductory chemistry sequence. This is the final course before upper level chemistry courses in the major (CHEM 425) and the last chemistry course for nonmajors unless students opt to take biochemistry. The CHEM 272 course is for nonmajors and has a large enrollment of pre-health students. CHEM 277 is for chemistry and biochemistry majors. These courses are unique in that many of the experiments have a bioanalytical focus. Students attend one 50 min lecture each week to prepare for the upcoming experiment in addition to the 3-h lab period (CHEM 277 has two 3-h meetings a week). Each week students are asked to complete a post-lab report that requires presentation and analysis of data collected and answering questions relating to theory or concepts involved in the experiment. Many of the exercises in CHEM 272 and CHEM 277 involve finding scientific information such as physical constants of compounds (density, pK\(_a\)) or relevant literature to learn more about a particular technique (spectrophotometry, titrations).

CHEM 425 is an instrumental methods of analysis course, a senior level course required by all chemistry and biochemistry majors. It is a four-credit course and fulfills the requirement for the analytical chemistry part of the curriculum. It has both lecture and laboratory components. In the laboratory, students have on average 6–12 h of hands-on experience operating research-grade instrumentation.

Students taking this course have to complete laboratory procedures described in a laboratory manual, but they are also encouraged to come up with original experimental protocols as the final course assignment. In both cases, student work success is directly related to their familiarity with physical and chemical properties of chemicals and the instrumentation setup. In that regard, student ability to pool together literature resources and be able to cite references becomes of critical importance.

The lab portion of the course involved writing 10–11 comprehensive lab reports that were based on the data collected during 6 h of lab work. Part of the lab report was interpretation of the results from a theoretical standpoint and required extensive use of literature to compare the results and find plausible explanations.

Finding information on physical and chemical properties of chemical compounds as well as information on limitations of the analytical methods was also important for general understanding of the experimental setup and was needed later to write a comprehensive “Materials & Methods” section of the report.

Face-to-Face Instruction

The librarian (Svetla Baykoucheva) did this instruction for the smaller courses (CHEM 277 and CHEM 425) and graded the assignments. The face-to-face sessions for the large course (CHEM 272), which was divided into 20–22 sections, were conducted by teaching assistants (TAs) who were trained by the librarian how to cover the material and grade the assignments. In the spring semester of 2014, these sessions took place in computer rooms and students did their assignment immediately after the face-to-face instruction session. In the next two semesters, the sessions of the sections were held in lecture rooms where students brought a laptop or tablet to the instruction.

During the first part of the face-to-face instruction, students were introduced to different publication formats (e.g., research paper, review article, conference proceedings) and some basic principles of searching for literature such as expanding a search using a “wild card”, or narrowing down results by time period, document type, and other criteria.

After getting familiar with the basic features of EndNote, students were shown how to perform an online search in PubMed directly from EndNote. This was followed by demonstrating different strategies for performing efficient searches in the literature databases, exporting references to EndNote, organizing and sharing references, creating a bibliography, inserting citations in a Word document, and formatting citations in a particular style.

A major part of the face-to-face instruction was devoted to strategies for finding properties of chemical compounds in several databases by using a chemical name, molecular formula, CAS Registry Number, or by drawing a structure (in Reaxys and SciFinder).

More details about the features of the databases covered in the face-to-face instruction are included on pp 1 and 2 in the Supporting Information.

Grading

The following grading system for the assignments was used (the numbers in parentheses are those of the correct answers): A (9–10), B (8), C (7), and F (<7) Tables 3–5 show the assignment results for the three courses.

Table 3. Distribution of Grades for an Information Literacy Assignment in an Undergraduate Course for Chemistry Nonmajors (CHEM 272) for Three Consecutive Semesters

<table>
<thead>
<tr>
<th>Course</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>F</th>
<th>Students(^f)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2014 Spring</td>
<td>332</td>
<td>32</td>
<td>5</td>
<td>4</td>
<td>373</td>
</tr>
<tr>
<td>2014 Fall</td>
<td>306</td>
<td>55</td>
<td>25</td>
<td>9</td>
<td>395</td>
</tr>
<tr>
<td>2015 Spring</td>
<td>311</td>
<td>61</td>
<td>50</td>
<td>9</td>
<td>431</td>
</tr>
</tbody>
</table>

\(^f\)More than 97% of students enrolled in the courses submitted the assignment.

The skills for using EndNote and creating bibliographies were evaluated by including questions in the assignment that required students to perform a search in a database, filter the results, export references to their EndNote libraries, create a bibliography with these references, and copy and paste this

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Table 4. Distribution of Grades for an Information Literacy Assignment in an Undergraduate Course for Chemistry Majors (CHEM 277) in 6 Semesters

<table>
<thead>
<tr>
<th>Course</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>F</th>
<th>Students</th>
</tr>
</thead>
<tbody>
<tr>
<td>2012 Fall</td>
<td>20</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>23</td>
</tr>
<tr>
<td>2013 Spring</td>
<td>28</td>
<td>11</td>
<td>0</td>
<td>4</td>
<td>43</td>
</tr>
<tr>
<td>2013 Fall</td>
<td>34</td>
<td>11</td>
<td>1</td>
<td>6</td>
<td>51</td>
</tr>
<tr>
<td>2014 Spring</td>
<td>18</td>
<td>5</td>
<td>1</td>
<td>1</td>
<td>25</td>
</tr>
<tr>
<td>2014 Fall</td>
<td>43</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>46</td>
</tr>
<tr>
<td>2015 Spring</td>
<td>19</td>
<td>3</td>
<td>0</td>
<td>1</td>
<td>23</td>
</tr>
</tbody>
</table>

“All students enrolled in the courses submitted the assignment.

Table 5. Distribution of Grades for an Information Literacy Assignment in an Undergraduate Chemistry Course (CHEM 425)

<table>
<thead>
<tr>
<th>Course</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>F</th>
<th>Students</th>
</tr>
</thead>
<tbody>
<tr>
<td>2011 Fall</td>
<td>24</td>
<td>8</td>
<td>9</td>
<td>3</td>
<td>44</td>
</tr>
<tr>
<td>2013 Fall</td>
<td>37</td>
<td>4</td>
<td>2</td>
<td>0</td>
<td>43</td>
</tr>
<tr>
<td>2014 Spring</td>
<td>39</td>
<td>6</td>
<td>3</td>
<td>1</td>
<td>49</td>
</tr>
</tbody>
</table>

“All students enrolled in the courses submitted the assignment.

Feedback from Students

Some of the questions on the assignment were used to obtain feedback from students about the instruction, the assignment, and to rank the resources. For example, students were asked to rank the resources covered during the instruction, by their usefulness. Reaxys and SciFinder were ranked as the most useful ones by many students. A significant number of students chose EndNote as the most useful resource. Learning how to draw chemical structures and find properties of chemical compounds was mentioned by many students as the most important information they had learned from the instruction.

Examples of feedback about the instruction and the assignment are shown in Figure 2.
together in designing and planning the content, logistics, and assessment elements of the instruction. Because of the large number of students who were accessing the databases and EndNote at the same time (all face-to-face sessions were performed in 1 week at the beginning of the semester), the librarian and the instructors had to resolve together any problems. The instructors valued the collaboration with the librarian and relied on her for selection of the resources and how these resources will be introduced to students.

One of the challenges that many academic librarians experience is convincing teaching faculty to include information literacy instruction in their courses. Demonstrating that information literacy instruction will benefit students is the most important factor in changing this attitude. Expanding information literacy to include bibliographic management and other new areas of interest to students and researchers might require reskilling of librarians who need to have working knowledge of these technologies. It also inevitably challenges the current concept of science information literacy and how librarians can contribute to it. Our future plans are to create a more coordinated program for gradually introducing students in different science courses to more and more sophisticated tools and approaches for finding and managing scientific information and avoid duplication of effort and repetition of content.

■ ASSOCIATED CONTENT

☐ Supporting Information
The Supporting Information is available on the ACS Publications website at DOI: 10.1021/acs.jchemed.5b00515.

Features of databases covered in the instruction, examples of assignment questions for CHEM 272 and CHEM 277, and a sample handout for CHEM 272 and CHEM 277 (PDF, DOCX)

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Notes
The authors declare no competing financial interest.

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Supporting information for the paper

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FEATURES OF DATABASES COVERED IN THE INSTRUCTION MODEL

EndNote Online (EN) (www.myendnoteweb.com)
- Comparing different bibliographic management programs.1
- Downloading the EN browser toolbar and the Plug-in for Microsoft Word
- Searching databases from EN and importing into EN references from databases
- Organizing and managing references
- Sharing references with others
- Creating bibliographies
- Inserting citations in Word documents

ChemSpider (www.chemspider.com)
Finding chemical and physical properties using a chemical name or molecular formula

Finding chemical and physical properties using a chemical name or molecular formula

- Searching for journal articles using the advanced (MeSH Indexing) option
- Filtering results by refining them by entering additional keywords (e.g., “adverse effects”), publication year, and document type (e.g., review)
- Exporting selected references from PubMed to EN

Reaxys (www.reaxys.com)
- Finding properties (e.g., melting point, bioactivity/toxicity properties) of chemical substances using a chemical name, CAS Registry Number, or molecular formula
- Drawing a molecular structure and finding properties of the chemical compound(s) corresponding to this structure
After performing the search (for example, on aspirin and cancer), users are asked to choose from the following options:

(1) ... references were found containing “aspirin and cancer” as entered
(2) ... references were found containing both of the concepts "aspirin" and "cancer"
(3) ... references were found containing either the concept "aspirin" or the concept "cancer"
(4) ... references were found containing the concept "aspirin"
(5) ... references were found containing the concept "cancer"

In the case of the search mentioned above, the terms “aspirin” and “cancer” could have been written in a reverse order, as “cancer and aspirin.” The appropriate option in this case would be option #2, “... references were found containing both of the concepts "aspirin" and "cancer." This option considers the individual words as separate concepts. A concept is broader than a research topic. It allows retrieving documents in which the particular key words might not have even been mentioned, but the indexers have added them to the records of documents, if they are related to the topic. For example, the index term that SciFinder uses for “cancer” is “neoplasm,” which is a broader concept. Another example is when a search on the drug Lipitor is performed. Lipitor is a cholesterol-inhibiting drug. It belongs to the group of statins. Even if a document on Lipitor had not mentioned the word Statins, the indexers will add it to the record of this document. The "concept" feature makes the search more comprehensive, as it takes into account synonyms and other terms that the user and the authors might have not thought about to use to perform the search. SciFinder will help users with relevant answers should they choose the first options.

- Removing duplicates (SciFinder searches simultaneously two large databases, CPlus, and MEDLINE, which cover some of the same sources.)
- Refining results by adding more keywords, narrowing down to specific publication year(s), and document type (review article)
- Analyzing results by index term, author, and source title
- Exporting selected references to EN
- Finding properties (e.g., melting point, bioactivity/toxicity properties) of chemical substances using a chemical name, CAS Registry Number, and molecular formula, or by drawing a molecular structure

Scopus (www.scopus.com)

- Narrowing down results by adding more key words or limiting them by publication year
- Finding journals that have published the highest number of articles on the topic
- Finding authors who have published the highest number of articles on the topic.
- Exporting selected references to EN

Web of Science (WoS) (www.webofknowledge.com)

- Using a “wild card” such as an asterisk (*) to expand a search
- Refining results by subject areas, adding more key words, limiting search results by document type (for example, review) or to particular publication year(s)
- Exporting references to EN
EXAMPLES OF ASSIGNMENT QUESTIONS AND STUDENT RESPONSES

Assignments were designed in SurveyMonkey. Detailed questions allowed students to practice what they learned during the face-to-face sessions. Some of the questions required students to give feedback about what they thought about the instruction and the assignment. Other questions provided information about student’s familiarity with the resources before the instruction. Students had to rank the resources covered during the instruction, based on how useful they could be for their current and future studies and research.

**All screen captures are reproduced with permission from SurveyMonkey**

**General questions on basic strategies for performing searches and refining results**

Example 1: Expanding and refining search results (Figure 1).

![Adding an asterisk (*) at the end of a word would allow you to retrieve:](image)

**Figure 1.** Screen capture from an online assignment in SurveyMonkey showing responses from students in a section of a large chemistry course (CHEM 272) to a question about using a “wild card” such as an asterisk.
Example 2. Strategies for refining search results (Figure 2).

Figure 2. Screen capture from an online assignment in SurveyMonkey showing responses from students in a section of a large chemistry course (CHEM 272) to a question about refining results from a literature search.

Questions related to EndNote Online (EN)

Example 3. Importing references from databases into EndNote Online (Figure 3).

Figure 3. Screen capture from an online assignment in SurveyMonkey showing responses from students enrolled in a chemistry course (CHEM 425) to a question about where references exported directly to databases are found in EndNote Online.
Example 4: Downloading the EndNote Browser Toolbar and the Microsoft Word Plug-In (Cite While You Write, CWYW) (Figure 4).

![Figure 4](image)

Figure 4. Screen capture from an online assignment in SurveyMonkey showing responses from students enrolled in CHEM 277 to a question (outlines in Example 4) about installing the EndNote Browser Toolbar and the Microsoft Word Plug-in.

Example 5. Exporting references from SciFinder to EndNote Online (EN) and creating a bibliography.

1. Perform a search in SciFinder using the following terms:
   phenylketonuria and child

2. Select the following option:
   ...references were found containing both of the concepts "phenylketonuria" and "child"

3. Refine results by document type, selecting Review
4. Refine results by Publication year to the period from 2005 to 2015
5. Remove duplicates (Tools menu)
6. Select the first 5 references from the results list and export them to your EN library
7. Find the references in the UNFILED group and add them to a new group that you name "Phenylketonuria"
8. Format a bibliography with the references in this group using the ACS Style, as shown in the Handout.
   (Hint: (1) Click on Select favorites to add the ACS Style to your favorites and select this style from the pull-down menu next to "Bibliographic style"; (2) Select the group "Phenylketonuria" (for "Bibliography"); (3) RTF ("File format"); (4) Click on "Preview and Print."
9. Copy the bibliography and paste it in the text box below.
Searching for literature and filtering search results

Example 6. Selecting the ‘concept’ option for references in SciFinder (Figure 5).

![Figure 5](image)

**Figure 5.** Screen capture from an online assignment in SurveyMonkey showing responses from students in a chemistry course (CHEM 277) to a question about selecting the “concept” option for references in SciFinder.

Example 7. Performing literature searches in SciFinder and refining results by Document Type (Review) and Publication Year.

Perform the following search in SciFinder: diet and phenylketonuria. On the next screen, select the following option:

…references were found containing both of the concepts "diet" and "phenylketonuria.

From the Tools menu, select “Remove duplicates.” Refine your results by adding an additional key word: click on the Refine tab and enter the word “child” in the dialog box. Refine your results to Reviews (Hint: click on the Refine tab, select “Document type” and check the box
next to “Review”). Refine your results by Publication year to the time period from 2000 to 2005. How many reviews were published during that period?

Example 8. Analyzing the search results in SciFinder by index term (Figure 6)

Example 9. Perform a search for literature in PubMed using the Advanced feature (MeSH Indexing) (Figure 7).

1. Click on the link for the “Advanced” option
2. Type “enzyme inhibitors” in the first box; select “MeSH Major Topic” from the pull-down menu on the left of this box; click on “Show index list” on the right of the box; double click on “Enzyme inhibitors.”
3. In the second box, type “cholesterol;” from the pull-down menu on the left of this box, select “MeSH Term;” click on “Show index list” on the right of the box; double click on “cholesterol.”
4. Perform the search and limit the results by time period (Hint: click on Custom and select the following time period: 1/1/2009-12/31/2010
5. Limit results to “Review.” How many review articles were published during this time period?
Figure 7. Screen capture from an online assignment, showing responses from students in CHEM 277 to a question (outlined in Example 9) requiring performing an advanced search in PubMed and narrowing down results by Publication Year and Document Type (Review).

Example 10. Searching for literature and filtering results in Web of Science (Figure 8).

In Web of Science, type "alcohol dehydrogenase" in the first box. Narrow down your results by entering the word "purification" in the box under "Refine results" and click on the search button next to this box. Refine the results to "Research area" by checking the box next to "Biochemistry and Molecular Biology" and clicking on "Refine." Which organization has published the highest number of articles on this subject?

Figure 8. Screen capture from an assignment in SurveyMonkey showing responses from students in CHEM 277 to a question requiring performing a search in Web of Science, refining results by entering additional key words, limiting them to a particular research area, and finding out which institution has published the highest number of documents on this topic.
Example 11. Searching for literature and filtering results in Scopus (Figure 9).

Figure 9. Screen capture from an online assignment, showing responses from students in CHEM 277 to a question requiring searching Scopus for literature and refining results.

Finding information about properties of chemical compounds

Example 12. Finding the CAS Registry Number of a chemical compound in SciFinder. In SciFinder, go to "Explore"—“Substance identifier” and type “aspirin.” Sort by "CAS Registry Number." Which of the following is the correct CAS # for aspirin?

- 216-40-08
- 123-64-79
- 50-78-2
- 89-24-563

Example 13. Finding properties of chemical compounds in Reaxys. In Reaxys, click in the box “Names and Formulas” and type “phenylalanine” for chemical name. In the column “Available data,” click on “Physical properties” and then on “Melting point.” What is the melting point (in degrees Celsius) that was reported in an article authored by Edwards et al.?

- 256
- 276
- 249
- 321
Example 14. Finding properties of chemical compounds in SciFinder and using the information to find other properties in Reaxys (Figure 10).

1. In SciFinder, under Substances, click on Substance Identifier and enter the following CAS Registry Number: 462-08-8.
2. Find the molecular structure of the compound corresponding to it.
3. Draw its structure in Reaxys (www.reaxys.com):
   Click on Structures and Reactions and select Substances. Double click in the window and draw the structure exactly as it was shown in SciFinder. If you have a problem opening the drawing window (it is Java-based), click on "Structure editor" at the bottom of this window and select Dotmatics Elemental.
4. Perform the search.

Which of the following properties WAS NOT listed among the Bioactivity/Ecotox properties of the first substance you have retrieved?

![Bar chart showing responses to the question](image)

Figure 10. Screen capture from an online assignment in SurveyMonkey, showing responses from students in CHEM 425 to a question (shown in Example 13), which required finding a molecular structure of a chemical compound in SciFinder, drawing its structure in Reaxys, and finding which of the Bioactivity/Ecotox properties listed under the question was not associated with this compound.
Example 15. Finding properties of chemical compounds in *ChemSpider* (Figure 11).

![Figure 11](image1.png)

Figure 11. Screen capture from an online assignment in SurveyMonkey, showing responses from students in CHEM 277 to a question that required using a molecular formula in ChemSpider to find the name of the corresponding to it chemical compound.

Example 16. Finding properties of chemical compounds in *PubChem* (Figure 12).

In *PubChem*, find property information for 3-Aminopyridine. Which of the following numbers corresponds to the molecular weight (in g/mol) of this compound as listed under "Computed Properties" in the "Chemical and Physical Properties" section

![Figure 12](image2.png)

Figure 12. Screen capture from an online assignment in SurveyMonkey showing responses from students in CHEM 277 to a question that required finding the molecular weight of a chemical compound in PubChem.
Questions aimed at obtaining feedback from students about instruction, assignment, and resources

Example 17. Feedback from students about the resources covered during the instruction (Figure 13).

![Screen capture from an online assignment in SurveyMonkey showing responses from students in CHEM 425 to a question about the resources covered during the instruction.](image)

Figure 13. Screen capture from an online assignment in SurveyMonkey showing responses from students in CHEM 425 to a question about the resources covered during the instruction.

Example 18. Did you find this instruction and the assignment useful? (Figure 14)

![Screen capture from an online assignment in SurveyMonkey showing responses from students in CHEM 272 to a question about the instruction and the assignment.](image)

Figure 14. Screen capture from an online assignment in SurveyMonkey showing responses from students in CHEM 272 to a question about the instruction and the assignment.
Finding and Managing Scientific Information
Svetla Baykoucheva (sbaykouc@umd.edu)

Research Guide: http://lib.guides.umd.edu/chemistryresources

Create an account for SciFinder

Create an account for EndNote Online
Difference between a Research article and a Review article

A research article reports data obtained in the lab. It includes a Materials & Methods section (also called “Methods” or “Experimental”) that describes how the experiments were performed. A review article discusses published research articles. It usually DO NOT have an experimental section.

Library Resources

UMD Libraries Web page: http://www.lib.umd.edu

White Memorial Chemistry Library: http://www.lib.umd.edu/chemistry

Literature databases

- Google Scholar
- Engineering Village
- EBSCO / Academic Search Premier
- PubMed
- SciFinder
- Scopus
- Web of Science

Property information databases

- ChemSpider
- CRC Handbook of Chemistry & Physics
- NIST Chemistry WebBook
- PubChem
- Reaxys
- SciFinder

EndNote Online

- Creating an account for EndNote Online (formerly, EndNote Web): www.myendnoteweb.com
- Other bibliographic management programs:
  - EndNote (software)
  - Mendeley
  - Papers
  - RefWorks
  - Zotero
  - Readcube

Install the EndNote Browser Toolbar and the Microsoft Word Plug-In
Collecting references with EndNote Online

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**New Reference:** allows creating a record manually; when clicking on the *Capture* tab in the browser EndNote toolbar, this form is automatically filled out for the article displayed on your computer.

**Searching databases from EndNote Online**

*Collect—Online Search:* allows searching databases (e.g., PubMed) and library catalogs directly from EndNote Online
Important: References directly exported from databases will be found in the UNFILED group in EndNote Online. Click on this group, select the references and move them out of the UNFILED group by putting them in a “New group” or in an existing group.
Searching Scopus

Images reused from Elsevier’s Scopus database, December 13, 2015
Searching SciFinder for literature (Perform a search on “cholesterol and statins”)

Screen captures from SciFinder are used with the permission of the Chemical Abstracts Service (CAS), a division of the American Chemical Society (December 13, 2015).

Important: Select the option “references were found containing both of the concepts…” SciFinder will help you with relevant answers should you choose the first options, “…as entered.”
Exporting references from SciFinder to EndNote Online

Select the references you want to export and click on the “Export” button at the upper right corner of the screen. In most cases, you need to choose the first option under “Citation Manager” as shown in the figure below.

If this option does not work, use “Tagged Format.” If you use this option, the references will be downloaded to your computer as a text file. Go to your EndNote library, select the tab “Collect,” then “Import references.” As shown on the figures below, upload the file that you have downloaded to your computer to the first box (Use Browse). Select SciFinder as an import option and choose where to place these references (e.g., in a New Group).
Inserting Citations in a Word document: Cite While You Write (CWYW)

- Inserting citations from your EndNote Online library into a Word document
- Downloading plug-ins for Word (a tab for EndNote appears in Word): Go to Help, then to “Browser Toolbars and Plug-ins”

Creating a bibliography in EndNote Online
Searching Web of Science (Search for statin* and cholesterol)

Placing an asterisk (*) at the end of a keyword expands your search and will retrieve articles that have both the word "statin" AND any other words that begin with it (e.g., statins).

To refine the search, enter additional key words (e.g., “adverse effects”) and/or limit the results to review articles as shown in the pictures below:

Refine your search by adding more key words (e.g., "adverse effects"). This will reduce the number of results.

Limit to review articles.

Select articles to export to EndNote.
Searching PubMed for literature (Advanced option)

Finding properties of chemical compounds in SciFinder by chemical name

Screen captures from SciFinder are used with the permission of the Chemical Abstracts Service (CAS), a division of the American Chemical Society (December 13, 2015).
Structure searching in SciFinder

Screen captures from SciFinder are used with the permission of the Chemical Abstracts Service (CAS), a division of the American Chemical Society (December 13, 2015).
Finding properties of chemical compounds in Reaxys

To draw a structure, click on “Structure Editor” and select “Java free: Dotmatics Elemental.” Search for chemical properties using these characteristics.

Double click in this window after selecting the structure editor.

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REFERENCES


