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Supplemental Materials for Building Data and Information Literacy in the Undergraduate Chemistry Curriculum

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CHEM 481 – Literature and Seminar I (Fall 2015)

Week	Summary of Activities	Assignments (for the next week)	Learning Goals A student should be able to…
1	**Introduction to Literature and Seminar** We introduce the course during the first week and set the stage for why this course is an important part of the chemistry curriculum. • *Student Introductions*. Who are you and what do you want to do after graduation? What is chemistry? Why do chemistry majors have to take this course? What do you want to get out of this course? • *Faculty Introductions*. Why do we team-teach? Why do you take this course? How does this course work? • *Introduction to this semester's theme*. Each semester, we choose a theme for the course. All papers that we read are related to that theme so students can build their understanding in a single area of chemistry. The theme changes in yearly; the Fall 2015 topic is metal organic frameworks used for carbon capture. Students are asked what they know about carbon capture and its applications in a think-pair-share activity.	• CATME survey • Information Literacy Test (ILT) pretest – taken in a proctored computer laboratory outside of the regular class meeting. • Vocabulary list for first paper (communication).	
2	**Effective Reading Strategies** The primary goal this week is to help students develop strategies to effectively read papers. • *Warm-up activity*. Student compare vocabulary, help each other understand the words they don't know and share how they found definitions. Instructors help when students are having trouble. • *Close reading strategies*. Each group summarizes a paragraph or figure from the text in a single, content rich sentence. We compare the sentences from each group to sentences from other groups and the instructor. We work through this reading assignment one paragraph / figure at a time. • *Introduction to Supplemental Information*. Students search for the electronic supplemental information (SI) for their article. In their groups, they define what the SI is, explain how it differs from materials contained in the paper, and identify factors that would explain why something would be included in the supplemental materials rather than the body of the paper. After students have a chance to work on this on their own, they participate by an instructor-led discussion.	• Vocabulary list for second paper (review). At this point, reviews are too long for many students so we ask them to read a focused part of the review.	…understand technical articles • list and define unknown vocabulary and ideas in a scientific article • restate the purpose and key findings of a scientific article • interpret data (what it says and what it does) Colors correspond to levels in Bloom's Taxonomy: knowledge, comprehension, application, analysis, synthesis, evaluation

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3	**Identifying Key Findings** This class is taught with a faculty member who works in the University Writing Center who demonstrates that by having good reading strategies, it's possible to understand papers that are outside of your area of expertise. (She has B.A./M.A. degrees in English/Journalism.) • *Warm-up activity*. Students assist each other understanding questions they had about the article. The instructor provides information as needed. • *What it says vs. what it does.* This activity is lead by the instructor from the writing center. Students are asked to read an article on happiness and then work through several paragraphs to identify the main point of the paragraph (what it says) and the reason why this paragraph was written, e.g. provide evidence or set context (what it does). • *Identifying key findings*. Students are asked to write a summary of a short section of the review. Students share these paragraphs and discuss them with the class so that everyone fully understands both the science discussed and how it fits into the review and field.	• Matrix of a journal paper (article). The matrix is a format we use to help students keep track of important information in articles. This helps them to keep track of what they've read and the important findings. The matrix elements are: author, year, DOI, purpose, techniques, key findings, remaining questions.	…understand technical articles • list and define unknown vocabulary and ideas in a scientific article • restate the purpose and key findings of a scientific article • interpret data (what it says and what it does) • analyze a scientific article for the most important outcomes of the research study
4	**Summarizing an Article: Writing** The goal of this class is to have students summarize a research article. This is challenging for students because they find it hard to summarize in their own words because the author is the expert AND because they have a hard time deciding what content is important and needs to be included. • *Warm-up activity*. As groups, students brainstorm about why reading the literature and writing are important skills. • *Collaborative summary*. The group is asked to prepare a summary of the article that they read. This gives the students an opportunity to discuss data, critique the paper, identify key findings and answer each other's questions about the paper. This is followed by a whole class critique (constructive criticism) of each group's writing. By examining strengths and weaknesses of group writing assignments, students develop ideas about what separates strong and weak writing. • *Individual summary*. Each student writes his/her own summary of the article based on the class discussion. They may use the group summary as a starting point.	• Research article summary. Students revised the summary of the research article they started in class. They were allowed to use their group summary as a starting point and were to incorporate things that they learned about effective writing from the in class discussion.	…understand technical articles • create a short summary in clear and concise language • restate the purpose and key findings of a scientific article • interpret data (what it says and what it does) • analyze a scientific article for the most important outcomes of the research study ...communicate effectively - written language • identify the relevance and application of the research • use formal written English • construct effective paragraphs • distill the most important ideas from a research article • distinguish between plagiarism, patchwork plagiarism and effective summarizing • construct an effective summary from research ideas and background
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5	**Ethics** The goal this week is to have students think about what constitutes scientific misconduct and why it occurs. • *Warm-up activity*. In groups, students brainstorm about examples of scientific misconduct and unethical behavior. • *Collaborative exercise*. As a group, respond to a case study involving possible misconduct. Decide your stance and be prepared to argue for it during discussion. • *Individual exercise*. Why is scientific misconduct a problem? Reflect and respond.	• Create a folder for the class within your RefWorks account (online instructions are provided)	*...manage chemical information* • recognize ethical practices for managing information *...communicate effectively - written language* • distinguish between plagiarism, patchwork plagiarism and effective summarizing *…recognize scientific misconduct (FFP – falsification, fabrication and plagiarism)*
6	**Finding Information: General Resources** The goal this week is to have students understand how to find information at a broad level. What types of information are appropriate for a given task? • *Warm-up activity*. In groups, students brainstorm about identify chemical information sources that you 1) use and 2) know about but don't use. Discuss as a class the characteristics of sources identified. • *Short presentation*. Students are reintroduced to the course's LibGuide and some of the general resources available in the library. • *Collaborative exercise*. As a group, choose the **best** online source to answer a series of chemical information questions. This took the format of an online scavenger hunt. Students are awarded credit for finding high quality sources quickly and a prize is given. • *Warm-up activity 2*. In groups, students list strategies for keeping current in the field of science/chemistry. • *Short presentation*. The instructors talk about their methods of keeping current with the literature, which included social media (Facebook / Twitter), RSS feeds and TOC alerts.	• Watch "information types" tutorial • Summary revisions • Take the RefWorks quiz in Canvas	*…discuss the structure of the chemical literature* • find an article from a citation in the chemical literature • recognize the purpose of a DOI • explain how information is communicated among scientists *...identify appropriate information sources* • identify the difference between peer-reviewed and non peer-reviewed articles • select high quality information sources *…use resources to find chemical information* • know the major chemistry databases & texts for finding chemical information • identify the best resources for starting a search ...manage chemical information • develop strategies to keep current in chemistry

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7	**Finding Information: Scholarly databases (Scopus)** The goal this week is to have students understand how to find information using a specific database. What characteristics does a particular database have that make it most appropriate for a particular search? • *Warm-up activity*. In groups, students find an important article on carbon capture AND explain why it is important. • *Collaborative exercise 1*. Conduct an author search in Google Scholar or Scopus. Report on differences between resources. • *Collaborative exercise 2*. Do a topic search fulfilling specific criteria (i.e. using limits). • *Collaborative exercise 3*. Create a reading list in RefWorks of recent articles that fulfill specific criteria given in class. Give a justification for selecting the articles to populate the list.	• Turn in Collaborative Exercise 3, in Acc. Chem. Res. style	*...identify appropriate information sources* • select high quality information sources *…use resources to find chemical information* • perform a comprehensive search on an author, molecule or topic • refine searches to target information • examine the relevance and importance of resources
8	**Data Management** The goal this week is to have students reflect on their current practices, learn about best practices, and develop strategies to incorporate data management into their process. • *Warm-up activity*. In groups, students are asked to provide reasons to provide good documentation and explain what would need to be included for the documentation to be considered "good" documentation. • *Short presentation*. An overview of tenets of research data management. • *Collaborative exercise*. Using the provided raw data files, each group should create a figure that includes: an annotated image of the Gummy Bear, chart of springiness per color of bear, and a legend.	• Methods and Documentation. Students develop a methods section and documentation for the Gummi Bear Challenge and submit the file, including the figure developed in class, using data management best practices.	*...manage chemical information* • recognize ethical practices for managing information • identify best practices for data management

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9	**Finding Information: Scholarly databases (SciFinder)** The goal this week is to have students understand how to find information using a specific database. What characteristics does a particular database have that make it most appropriate for a particular search? • *Warm-up activity*. Students are asked to compare Scopus and SciFinder based on their prior knowledge of the database. They are asked to list the information that they would be able to access in each database and asked which database they would use to find specific types of information. • *Short presentation*. Interspersed between group activities, students are shown features of SciFinder. They are asked to put these skills into immediate practice with the activities. Students are referred to SciFinder tutorials for more information. • *Collaborative exercise 1*. Students are given the structure of the molecule (one used in the instructor's research) and asked questions about the molecule, its identifying information, its physical properties, the vendors who sell it and the number of papers published that contain materials with the structure. • *Collaborative exercise* 2. Students are asked to do a reaction search to make the molecule. There were >20 syntheses, so students are required to prepare a bibliography of all of these references using a reference manage (in this case RefWorks). • *Collaborative exercise 3.* As a collaborative group, students are asked to search on an author in SciFinder and look at the source of his references, the most recent references, citations, and areas of publication. • *Collaborative exercise 4*. Students are asked to do a topic search and refine this search to find resources to introduce them to a field. For all exercises, students are asked to make comparisons between their SciFinder search and search in other databases. 1 = Merck Index & CRC Handbook; 3 & 4 = Scopus. They are asked to make a recommendation for which resource they'd use and justify their answer.	• CATME Evaluation • Students wrote up their in class activities and submitted them through the learning management system.	*...identify appropriate information sources* • select high quality information sources *…use resources to find chemical information* • identify the best resources for starting a search • perform a comprehensive search on an author, molecule or topic • refine searches to target information • examine the relevance and importance of resources

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10	**Finding Information: Scholarly databases (PubMed and Patents)**
	The goal this week is to have students understand how to find information using a specific database. What characteristics does a particular database have that make it most appropriate for a particular search?
	• *Warm-up activity*. Students participate in a think-pair-share in their groups focused on two questions.
	  o Why does chemistry care about the patent literature?
	  o What types of information can you find in PubMed?
	• *Introduction to PubMed*. Students are given a short introduction to the indexes in PubMed and then shown the interface. Special emphasis is placed on the unique mechanics of PubMed's filtering and the MeSH subject headings.
	• *PubMed in action*. Students are given a prompt to find an article. " I'm interested in papers on air pollution in the Americas, as it relates to people. Something in the past 5 years. I don't want to know about smoking and I'm curious to see what's out there as it relates to children. Four groups will find a review, four will find a Clinical trial, and four will find a research article. Limit to get as few results as possible record that number, pick one that the group thinks is the "best," and *then* find a referenced review article. Explain your strategy and criteria for selecting the "best." Have a detailed note-taker; you will turn this in for credit.
		• Turn in "PubMed in action" assignment that is started in class	*…discuss the structure of the chemical literature*
			• explain how information is communicated among scientists
			...identify appropriate information sources
			• select high quality information sources
			…use resources to find chemical information
			• know the major chemistry databases & texts for finding chemical information
			• perform a comprehensive search on an author, molecule or topic
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11	**Searching in Action: Learning about New Topics** The goal of the next three weeks is to help students develop the strategies they need to begin research on a new area of chemistry. This is to prepare students to do this during the second semester of Lit&Sem where they need to prepare a short review (4,000-5,000 words) and talk (13-16 minutes) on a modern research area in the chemical sciences. • Introduction. Students are introduced to the Lit&Sem II project. • *Warm-up activity*. Students are given a C&EN article to read on a topic that a student might choose for their Lit&Sem II project. As a group, they are asked to identify the strategies they'd use to learn more about the topic; conduct a lit search so they could begin research; and identify next steps after this initial lit search. • *Whole class discussion*. As a class, discuss strategies to begin research on a broad topic and ways to narrow down topics. • *Collaborative searching*. Students spend about half of the class period learning more about the topic, developing key words, looking at combinations of search terms, and identifying 2-3 articles that they would use to get a broad overview of the field. • *Whole class discussion*. Students report on the articles they found and these choices are critiqued by the class (relevance, breadth, timeliness, quality, etc..). • *Wrap-up*. Students are asked to refine the strategies they developed during the warm-up.	• Students were encouraged to explore C&EN, science magazines, social media and reflect on the problems they want to solve in their careers to help them identify potential topics for the Lit&Sem II project. (Not required. The best students began searching. In the future, all students will be asked to turn in search results.)	*...identify appropriate information sources* • select high quality information sources *…use resources to find chemical information* • know the major chemistry databases & texts for finding chemical information • identify the best resources for starting a search • refine searches to target information • examine the relevance and importance of resources • find additional resources by following citations (in and to an article) *…understand technical articles* • analyze a scientific article for the most important outcomes of the research study

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12 and 13	**Searching in Action: Identifying and Choosing Resources** The goal of these two weeks (one of which is the week before the Thanksgiving Holiday) is to continue to work collaboratively on comprehensive search strategies and to document the process. • *Short presentation.* Recapped the previous week's content, reiterating the iterative process of searching for information. • *Group project.* Introduced the group project for these two weeks: to complete a preliminary literature search on the topic of detecting spoiled meat, http://cen.acs.org/articles/93/i45/Nanotube-Sensors-Sniff-Spoiling-Meat.html). o *Keywords*. Students receive a C&EN news blurb and an article from ACS Sensors. Groups begin to analyze the sources for keywords and additional sources o *Topic Exploration*. Using Scopus AND SciFinder, groups are instructed to begin the literature search, employing all the techniques previously discussed in class o *Background Information*. Groups identify the three most valuable review articles to help them learn about the broader field. References are provided in ACS citation style and a direct link (DOI). Students must document their search process and justify why these three reviews are the most valuable. Furthermore, groups should identify which of the three articles has the most citations and provide a bibliography of all the citing articles from 2015 that are relevant to the topic. o *Topic Development*. Using what you have just learned, pose a research question, identify the three most important papers related to this topic (2010-present) and provide a bibliography. Explain the search strategy and the justification for these three papers.	• Preliminary Literature Search. As groups, students submit their solutions to the group project.	*...identify appropriate information sources* • select high quality information sources *…use resources to find chemical information* • know the major chemistry databases & texts for finding chemical information • identify the best resources for starting a search • refine searches to target information • examine the relevance and importance of resources • find additional resources by following citations (in and to an article) *…understand technical articles* • analyze a scientific article for the most important outcomes of the research study
14	**Chemistry ILT (Information Literacy Test) and SALG (Student Assessment of Learning Gains)** Both of these assignments are completed individually in the proctored campus computer testing centered. A copy of the ILT is available upon request from the corresponding author.	• CATME Evaluation	

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15	**Final Exam** Students are given a two-hour exam. The exam has 3 parts: Part I - Reading Strategies (no devices, minimum 30 minutes), Part II – Search Strategies (no devices), and Part III – Search Strategies (computer allowed). Part I is completed individually and Parts II and III are completed as a group. Each student is provided with a printed copy of a paper from the primary literature *(2)* and a paper copy of the exam. In Part I, students are asked questions about how they would find and cite information, the structure of a paper (including supplemental information), the literature, and the science reported in the paper. In part II, students are asked questions about the search strategies they would employ to find chemical information. After the group turns in Part II, they are given Part III and are allowed to use electronic resources. Students are asked to find data about authors, chemical properties, vendors, and related papers. The final exam is available on request from the corresponding author.		…discuss the structure of the chemical literature • find an article from a citation in the chemical literature • recognize the purpose of a DOI ...identify appropriate information sources • select high quality information sources …use resources to find chemical information • know the major chemistry databases & texts for finding chemical information • identify the best resources for starting a search • perform a comprehensive search on an author, molecule or topic • refine searches to target information …understand technical articles • restate the purpose and key findings of a scientific article • interpret data (what it says and what it does) • analyze a scientific article for the most important outcomes of the research study