ASSIGNMENT & CHECKLIST FOR UNDERGRADUATE RESEARCH FOR CHEMISTRY MAJORS

UCF catalog description: Students are required to submit an Undergraduate Research Report (URR) for evaluation no later than the date posted by the department in the semester they intend to graduate. The report must meet or exceed the departmental requirements described below.

Undergraduate Status: The final report must be submitted during the students last semester of undergraduate research, no later than 3 weeks before the last day of the semester. The report may be submitted sooner at the discretion of the student's faculty advisor.

General Goal: The goal of the undergraduate research report is for the student to write a clear, logical, and accurate research report addressed to other chemists in the discipline that demonstrates an ability to follow genre conventions as well as an understanding of theory and concepts related to the research.

Assignment Details: Journal articles are an important dissemination method chemists use to exchange information about original research. The URR is designed to help prepare students for this type of writing. Each student is required to write the report, based on their research, to be modeled after a technical paper written in a peer-reviewed journal related to the field of study. The checklist below is to be used to help guide the writing the process.

Assessment & Grading: The evaluation rubric describes how the reports will be scored. Each URR must score an average of at least 16 points (out of 20) to be considered acceptable. At least four reviewers will score the URR. Revision may be required before the report is considered acceptable, and the student may need to clarify sections of the report (regardless of an average score above 16) at the request of a reviewer.

Final Thoughts: Novice writers often get frustrated when they sit down to write their report, on their own, in one attempt. Expert writers understand that not only is writing a process that involves multiple drafts and revision, but that it almost always involves other people. Chemists often write journal articles with co-authors and most of the prestigious manuscripts go through intense peer review before being published. Because of this, you are encouraged to model this behavior and use your resources, including your faculty advisor, graduate students in your lab, and your peers when writing the report.

Texts that may be helpful include:

- Belcher, W. L., *Writing Your Journal Article in 12 Weeks*. California: SAGE Publications, 2009.
- Coghill, A. M., Garson, L. R., *The ACS Style Guide: Effective Communication of Scientific Information*. ACS, 2006.
- Robinson et al., *Write Like A Chemist.* New York: Oxford University Press, 2008.

CHECKLIST FOR UNDERGRADUATE RESEARCH

First Semester

- **Safety training:** before entering a laboratory to perform research, safety training is required through UCF Environmental Health and Safety. http://www.ehs.ucf.edu/classregister.html

- **Volunteer service agreement:** all persons working at/for UCF without pay is required to sign a Volunteer Service Agreement. This service agreement must be signed whether or not you are registered for research credit. Contact the department office for a copy of this form.

- **Initial literature search:** before performing research it is important to understand the methods and procedures as well as the concepts behind the research you will be performing.
    - Review articles by your research group related to research you will be performing
    - Review articles by other authors related to the research you will be performing
    - Review methods/experimental procedures you will be using

Ongoing/throughout your research experience

- **Read related literature**

Identify and read related literature. Consider how your information relates to what has already been published. Does it fill a gap or extend previous research? This is a good time to set up bibliographic software like Endnote.

- **Keep an up-to-date notebook**

Your laboratory notebook is a legal document which should be clear and complete. Include all information regarding experimental setup since details of an experiment may change over time and may be forgotten. Make notes about why you are performing experiments, what significance the results have, and ideas for future experiments.

- **Continually organize your work**

For every new experimental method and/or instrument used, write a few paragraphs of background information. This will be useful when drafting you final report. Develop tables and graphs of your data (if appropriate). Make notes about the importance of the data/data trends. Share these thoughts with you faculty advisor and colleagues when appropriate.

- **Prepare to write**

Read over the checklist for your graduating semester. Write down deadlines for your submission on a calendar so you do not forget when the first draft and final draft of the URR is due.

THE UNDERGRADUATE RESEARCH REPORT (URR)

Graduating Semester

- **Find 1-3 Model Articles** (preferably from a journal in your field)

Use these to examine the structure and audience of the journal. This is an important step to examine how information is presented. How does the article start? If you only read the first paragraph would you know what the article is about? How does the author write the methods, result, and discussion section? How are references cited?

- **Literature review**

Identify and read related literature. Review the articles you have read in the past and determine if they will be useful when writing the URR. Organize all possible sources and continue to update your bibliographic software (Endnote). Consider how your information relates to what has already been published. Does it fill a gap or extend previous research? Start summarizing what you have read in your own words to avoid plagiarism.

- **Outline & Abstract**

Make an outline of the sections of your report. What pieces of evidence/data do you need to present to make your point (you may have to pick and choose from multiple experiments you performed during your research). Decide on important aspects of your audience: who will read this? What is the purpose for writing the research? Why would someone find it important? Use the outline to construct an abstract. Abstracts involve a statement about what was done, the identification of methods used, and a report of the principle findings. Once you have completed your outline and abstract, get it approved by your faculty advisor.

- **Draft**

Once your faculty advisor has approved your outline and abstract, develop the paper into a full draft keeping in mind that the purpose of research is to fill a gap or extend previous research? Some writers prefer to write the introduction last at which point they readdress their abstract and modify it to reflect what the report really ended up being about. It is important to compare and contrast your work to what has previously been done. Consult similar journal articles and note the style of their writing, the general layout and presentation of data.

- **Peer-review and Revision**

Writing in chemistry is almost always a collaborative effort. Most chemistry manuscripts are peer reviewed and must be approved by multiple reviewers before being published in a journal. One you have a completed draft of you URR, you are ready for peer-review. There are a great student resources provided by the authors of "Write like a Chemist" which are a great way to get the most out of the peer review process. Once you have completed the peer-review process, revise your report. The peer-review process may be repeated or you may choose to have other colleagues and/or graduate mentors review you report.

- **Submission to your faculty advisor**

The first draft of the URR must be submitted to the research advisor no later than 6 weeks before the last day of the semester. Failure to do so may delay your graduation. You will most likely be

given back your paper with a list of revisions. When this happens, revise your paper in a timely and thorough manner and re-submit to your advisor.

Final submission

One your faculty advisor has approved your URR submit the final draft to your advisor no later than 3 weeks before the last day of the semester for dissemination to the faculty review committee.

Additional Resources

- UCF Library – reference guides, literature searches
- Writing center – student consultations, writing resources
- Texts that may be helpful include:
    - Belcher, W. L., *Writing Your Journal Article in 12 Weeks*. California: SAGE Publications, 2009.
    - Coghill, A. M., Garson, L. R., *The ACS Style Guide: Effective Communication of Scientific Information*. ACS, 2006.
    - Robinson et al., *Write Like A Chemist.* New York: Oxford University Press, 2008.

Journal Article Review

Title:
Author(s):
Journal:
Publication date:

Before reading an article, ask yourself: What am I looking for in this article? Not all articles are created equal and not all articles are relevant to your research.

1. Read the title. It should summarize the work of the article well and help you to clarify your expectations of the paper.
2. Read the abstract carefully and try to understand it. Abstracts are as difficult to read as they are to write. By now, you should have a good idea of what the paper is about and it may be obvious that the paper does not answer your questions. If this is true, move on, but be conservative because the authors' interpretation of the research presented in the abstract may not be the same as yours after reading the full paper. **Never** cite an article after having read only the abstract!
3. Picture time. Flip through the article and study the figures, illustrations, and tables, including the legends. It will probably become necessary to consult the Methods and Results section to clarify figures and understand the experimental design. If the article is closely related to your research, closely examine the techniques described in the Methods section. There may be problems there, but more likely there will be a new, perhaps better, approach to your own research. It should be clear to you by now whether this paper will be truly helpful. If so, now it is time to read the article from start to finish and answer the questions below.

Abstract: the abstract provides a summary of the entire article.
What topic are the authors studying?
What was their primary finding?

Introduction/Literature: The introduction/literature review provides information about past studies that have been done on this topic.
What are some of the most important past findings on this topic?
How have these past studies led the authors to do this particular study?

Methods: The methods section provides information by which a study's validity is judged. It requires a clear and precise description of how an experiment was performed and the rationale for chosen methods.
What type of experiment was performed? How was the experiment performed?
Why was this procedure chosen? What is the justification of the experimental design?

Data/Results: The data/results section presents the author's data and provides information about what the authors found when they analyzed their data.
What methods to the authors use to present their data?
What were some of the authors' main findings?

Conclusion/Discussion: The conclusion or discussion section summarizes the authors' main findings and explains why the findings are so important.
What were the authors' overall findings?
Why are these findings important?
What limitations of the study do the authors identify (if any)?
What suggestions for future research do the authors make (if any)?

Adapted from Florida International University, Dr. Laurel S. Collins, Department of Earth Sciences
http://www2.fiu.edu/~collinsl/Article%20reading%20tips.htm

Peer-Review – Undergraduate Research Report

http://www.oup.com/us/companion.websites/9780195305074/student_resources/pdf/peer_memo/6_Journal_Peer_Review_Memo.pdf

Three-Step Process: Write a memo to your classmate in which you offer specific advice to help with revisions. The steps suggested below will help you review your partner's draft and provide feedback that will lead to an improved paper.

STEP 1: Before you begin, ask your partner what kind of feedback would be most useful. Make a list of your partner's requests.

1.
2.
3.

STEP 2: Use the questions below to guide you in reviewing your partner's draft. Later, in Step 3, use your observations to provide relevant feedback. **It is critical that your feedback be detailed enough to give your partner a clear strategy for improving the draft; thus, include specific examples from the draft, when appropriate, and explicit changes that you think will enhance the report.** "Actionable" suggestions should be the outcome of your memo.

1. How well does your partner's draft address the intended audience?
2. How easy is it to follow the organization of your partner's draft (based on Figures 3.1, 4.1, 5.1, and 6.1) ?
3. How clear and concise is your partner's writing?
4. To what extent has your partner followed through on promises made in the Introduction?
5. To what extent has your partner eliminated redundancy from the report?
6. How appropriate is your partner's use of citations and references?
7. How clear and well written are your partner's title and abstract?
8. How appropriate is your partner's use of writing conventions (e.g., tense and voice, abbreviations and acronyms, word choice, formatting)?
9. How accurate is your partner's grammar and mechanics (e.g., parallelism, punctuation, subject/verb agreement)?
10. How accurate is the science content?
11. How is the overall appearance and formatting of the entire report?

STEP 3: Write a memo to your partner. Provide feedback that parallels the type of feedback that you would like to receive from a peer. Remember to point out both the strengths and weaknesses of the written work. Give specific examples from the draft and suggest changes that will help your partner improve his/her writing.

Start your memo with the following:
To: (your partner's name)
From: (your name)
CC: (your instructor's name)
Date:
Re: **Review of your URR**

Evaluation of Chemistry Undergraduate Research Reports
(URR Rubric)

The following represent areas of proficiency that will be evaluated when the final Undergraduate Research Report submitted by a student enrolled in their fourth semester hour of credit are evaluated by the department Undergraduate Research Evaluation Committee.

A rating scale of 1 to 5 (highest) will be used and a total score of 16(20 maximum) will be used as an acceptable/unacceptable guideline. The student must write the report under the direction of the appropriate faculty member who will approve the report before it is sent to the review committee.

Style - The format and style used to prepare the final report must conform to that acceptable for publication in peer reviewed scientific journal. The American Chemical Society Style Guide or the UCF Undergraduate Research Journal Style requirements can be used or as an alternative the style required by a specific journal can be used.

0	No format or style evident.
1	Limited format and style. Missing four from [4]
2	Limited format and style. The format and style missing three from [4]
3	Limited format and style. The format and style missing two from [4]
4	Limited format and style. The format and style missing one of the following: correct use of literature citations, correct numbering of tables/figures/equations, artwork (chromatograms, reaction schemes, etc.) are easy to read, clear/concise writing that avoids the use of slang/jargon, active/passive voice used appropriately, consistent use of verb tenses within a paragraph/section, correct use of grammar/punctuation/abbreviations
5	The format and style used to prepare the final report conforms to that acceptable for publication in peer reviewed scientific journal.

Literature Review - The final report must show evidence that the student has performed a review of the current scientific literature. The text of the report must be prepared to demonstrate that the results of that literature review have been assimilated into the study as appropriate.

0	No review of literature.
1	Literature review and assimilation into the context of the report are poor.
2	Literature review or assimilation into the context of the report is poor.
3	Literature review and assimilation into the context of the report are limited.
4	Literature review or assimilation into the context of the report is limited.
5	Literature review is complete and appropriate assimilation into the context of the report.

Content of the Report - Key components of the report shall include as a minimum requirement the following: Introduction, Experimental, Results and Discussion, and Literature Citations. The report will accurately reflect the nature and scope of the study and will concisely summarize the final results and conclusions. The student must demonstrate through the written report that he/she has a firm grasp of the topic that is the focus of the study.

0	Three or more key components missing. Report reflects the nature/scope with without concise summary of final results and conclusions and student demonstrated lack of knowledge of the topic that is the focus of the study
1	Two of the key components missing. Report reflects the nature/scope with without concise summary of final results and conclusions and student demonstrated lack of knowledge of the topic that is the focus of the study
2	One of the key components missing. Report reflects the nature/scope with without concise summary of final results and conclusions and student demonstrated lack of knowledge of the topic that is the focus of the study
3	Key components included. Report reflects the nature/scope with without concise summary of final results and conclusions and student demonstrated lack of knowledge of the topic that is the focus of the study
4	Key components included. Report reflects the nature/scope with without concise summary of final results and conclusions or student demonstrated lack of knowledge of the topic that is the focus of the study.
5	Key components (Introduction/Experimental/Results and Discussion/Literature Citations) included. Report reflects the nature/scope with concise summary of final results and conclusions. Student demonstrated in-depth knowledge of the topic that is the focus of the study.

Critical Evaluation of Data/Results - Experimental procedures, collected data and results must be presented in a clear and concise fashion and the significance of those procedures/data/results will be interpreted in a fashion that demonstrates the significance and usefulness of the study.

0	No evaluation of procedure/data/results.
1	Incomplete evaluation of procedure/data/results and significance of procedures/data/results not demonstrated.
2	Incomplete evaluation of procedure/data/results or significance of procedures/data/results not demonstrated.
3	Procedures/data/results presented clear but not concise and significance of procedures/data/results partially demonstrated.
4	Procedures/data/results presented clear but not concise or significance of procedures/data/results partially demonstrated.
5	Procedures/data/results presented in a clear and concise fashion. Significance of procedures/data/results interpreted to demonstrates the significance and usefulness.