Physics 602: Capstone II
T 9:00-10:30/(R 12:40-1:40)
HSC118/(HSC116)

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Overview

The focus in this second semester of capstone is on:

(a) completing your research – i.e. collecting and analyzing data, and
(b) presenting your research.

You are required to do the latter by four different means:

- Scientific article ("thesis")
- Popular article
- Poster presentation*
- Oral presentation*

*Both oral and poster presentations are required for the Department, and one of these must also be presented to the College at the Undergraduate Research Symposium (URS) on April 25 – <u>modified for a general (College-wide) audience</u>.

Grade Allocation

Completion of research		
Research advisor's evaluation	25.0 %	50.0 % total
Capstone instructor's evaluation	12.5	
Student's self-evaluation	12.5	
Presentation of research		
Scientific article	12.5 %	50.0 % total
Popular article	12.5	
Oral presentation	12.5	
Poster presentation	12.5	

Letter Grade Assignment

A	93 – 100 %
A-	90 – 93
B+	87 – 90
B	83 – 87
B-	80 – 83
C+	76 – 80
C	66 – 76
C-	62 – 66
D	55 – 62
F	0 – 55

Expectations & Outcomes

The grades in each of the components listed above will be divided and awarded according to the following expectations and outcomes.

Completion of Research

1. **The student must spend adequate time each week on his or her research** – i.e. in the lab, observatory, etc. The amount of time required will vary by project and by week, but I recommend a <u>minimum average of 10 hours per week spent on research alone</u> – i.e. not including capstone course meetings, meetings with your research advisor, or time spent on your articles, poster(s), and talk(s). The biggest disappointment students have in Capstone is that they don't finish collecting good data. While this can be due to the normal trials and tribulation of scientific experimentation (equipment hassles, false starts, etc.), the

number one culprit is inadequate time spent in the lab. Logging lots of hours early on will enable you to go beyond initial equipment hassles or false starts. (Conversely, the biggest reward students experience in Capstone is getting an experiment to work and collecting good data.) Your research advisor will be asked to weigh your invested time as part of their evaluation. Your capstone instructor will also periodically ask you about the time you are investing, and will use this in his or her evaluation. Finally, *you* will be asked to make an honest judgment about your own time investment, for your self-evaluation.

2. **The student must make reasonable progress towards his or her research goal.** This will largely be ensured by meeting the first expectation above (proper time invested in the lab). However, it is possible to spend time inappropriately or inefficiently. The best way to ensure that you don't waste the time you are spending in the lab is to communicate frequently with your research advisor. He or she will help keep you on task. Your advisor, capstone instructor, and you will be asked to consider progress as the second criteria in the final evaluation of your work.
3. **The student must demonstrate an advanced understanding of his or her research.** This is distinct from the first two expectations above, since it is possible to work for long hours and make good progress on a project without fully understanding its context, subtleties, and implications. The level of understanding achieved should be appropriate to the advanced (senior) undergraduate level, preferably bordering on the graduate level. This will best be facilitated by reading background literature and by frequent communication with your advisor. Advanced understanding is the third criteria that will be considered in your final evaluations.

   Assessment of the above outcomes will take place informally throughout the semester during your weekly capstone course meetings, during meetings and lab work with your advisor, through readings of your articles, and during your presentations. For example, your advisor may choose to assess your level of understanding (criteria #3) through informal discussions with you throughout the semester, via specific questions asked immediately following your departmental oral presentation, and via his or her reading of your final research article ("thesis"). This assessment of your understanding is independent of the assessment of your presentation and article themselves – though they will also be assessed based partly on content and correctness (see below).

Presentation of Research

1. **The student must write a thorough research article**, typeset in LaTeX and formatted to the specifications of a prominent professional journal in the same research (sub)field. Your capstone instructor will hold a workshop to train you in this writing style – though by this point you have already experienced it through past classroom and journal club presentations. The article will be graded by the capstone instructor based on timely completion of drafts, content, correctness, clarity and format. Final articles will be archived by the department for posterity.
2. **The student must write a popular article about their research**. The format should be similar to that of popular science articles found in the mass media (e.g. New York Times, National Geographic, Discover Magazine, etc.). Your capstone instructor will hold a workshop to train you in this writing style. The purpose of this assignment is twofold: (1) Far too many professional scientists lack the ability to effectively communicate their research to non-scientists. This type of communication is important not only for improving the science literacy of the public and inspiring future scientists, but also sometimes for convincing others to fund your work. (2) Second, your parents and (non-physics major) friends will likely be interested in what you are doing for capstone, but they probably won't understand your presentations or research article. This popular article is something you can share with them to help them understand what you are doing. Popular articles will be graded by the capstone instructor based on timely completion of drafts, content, correctness, clarity and format. Final articles will be archived by the department.
3. **The student must deliver an oral presentation of their research to the physics department** at one of the Thursday lunch talks (see schedule below). It should last roughly 30 minutes and allow for 10 to 15 minutes of questioning. The presentation should be technical, but at the same time contain proper background (and avoid being *overly* technical) so that it can be <u>understood by second semester physics freshmen</u>. To help in keeping the level appropriate, <u>you are permitted to show only one equation</u> to the

audience (but encouraged to show *none*). Additional equations may be included only with prior permission from the capstone instructor. This will encourage you to explain (the same) physical concepts via analogy, demonstration, or in other (non-mathematical) ways. Your capstone instructor will hold a workshop to help train you in presentation preparation and delivery – covering not only speaking but also (PowerPoint) slide design. Presentations will be graded by the capstone instructor based on timely completion of drafts, content, correctness, clarity and format.

4. **The student must create and display a poster of their research to the physics department.** Your final poster will be displayed in the hallway outside the department – possibly for years to come. The poster should be technical, but at the same time contain proper background (and avoid *overly* technical content) so that it can be understood by physics freshmen. To help in keeping the level appropriate, you are permitted to include only one equation on your poster (but encouraged to include *none*). Additional equations may be included only with prior permission from the capstone instructor. Your capstone instructor will hold a workshop to help train you in poster design. Posters will be graded by the capstone instructor based on timely completion of drafts, content, correctness, clarity and format.
5. **The student must present his or her capstone research at Westminster's Undergraduate Research Symposium (URS) on April 25.** You must submit an abstract for an oral presentation. If you are not granted an oral presentation, you must do a poster presentation. You are permitted to adapt your departmental talk for this purpose, but it will need to be modified to the appropriate length and appropriate level: for a college-wide non-physicist audience. No equations are permitted to be shown in this talk. Your capstone instructor can help you develop alternative ways to present information found in equations. If you instead present a poster, you must consult with your capstone instructor as to whether your departmental poster is appropriate for URS, or whether modifications are warranted.
6. **The student must participate in peer review of the articles and presentations of the other physics capstone students.** Peer review is essential to vetting and improving the quality of scientific results. You are required to attend each of your fellow capstone students' presentations (both departmental and at URS) and to read all of your fellow capstone students' articles and poster displays. (You also must attend all non-student departmental journal club talks – see schedule below). At each of these talks, you must ask at least one question of the presenter. Furthermore, you will each be given evaluation forms on which you must provide written reviews of each of your fellow capstone student's presentations and articles. You will submit these forms to your instructor who will then anonymize them and provide each of you with the evaluations from your peers. Note that you will be graded only on your participation in peer-reviewing others, but none of your grade will be based on others' peer reviews of you. I.e., your grade will come only from your capstone instructor and advisor (and yourself), not from other students. The anonymized reviews you receive are intended entirely as feedback for you to consider for your own improvement. Your instructor will also provide you with his or her own feedback. Your grade for the peer review aspect of the course will be based on your attendance at talks, your asking of at least one question at each talk, your submission of the peer review forms for your classmates' work, and the quality of your reviews of your classmates' work. By quality, I mean that you need to write more than just a few words (E.g.: Don't just write "Good").

Schedule

Day	Date	Class Time (T 9:00 - 10:30 a.m.)	Talk Time (R 12:40 - 1:40 p.m.)
T	17-Jan	Introduction	
R	19-Jan		
T	24-Jan	Error analysis workshop	
R	26-Jan		
T	31-Jan	Research article writing workshop	
R	2-Feb		
T	7-Feb	Popular article writing workshop	
R	9-Feb		
T	14-Feb	Poster design workshop	
R	16-Feb		
T	21-Feb	Oral presentation workshop	
R	23-Feb		
T	28-Feb		
R	1-Mar		Tom Oberst
T	6-Mar	Spring Break	
R	8-Mar	Spring Break	
T	13-Mar		
R	15-Mar		Jim Adams
T	20-Mar	Progress meeting	
R	22-Mar		Physics faculty TBD
T	27-Mar		
R	29-Mar		Physics faculty TBD
T	3-Apr	First drafts due: poster, talk, research article, popular article	
R	5-Apr	Easter Break	
T	10-Apr	Monday classes meet	
R	12-Apr		Physics faculty TBD
F	13-Apr	URS final poster draft due	
M	16-Apr	URS poster must be submitted to AV for printing	
T	17-Apr	Progress meeting	
R	19-Apr		Physics senior TBD
T	24-Apr		
W	25-Apr	Undergrad Research Symposium (URS)	
R	26-Apr		Physics senior TBD
T	1-May	Final drafts due: poster, research article, popular article	
R	3-May		Physics senior TBD
T	8-May	Peer reviews due	