Talk DD05:

Assessment in Junior Physics Laboratory

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Abstract

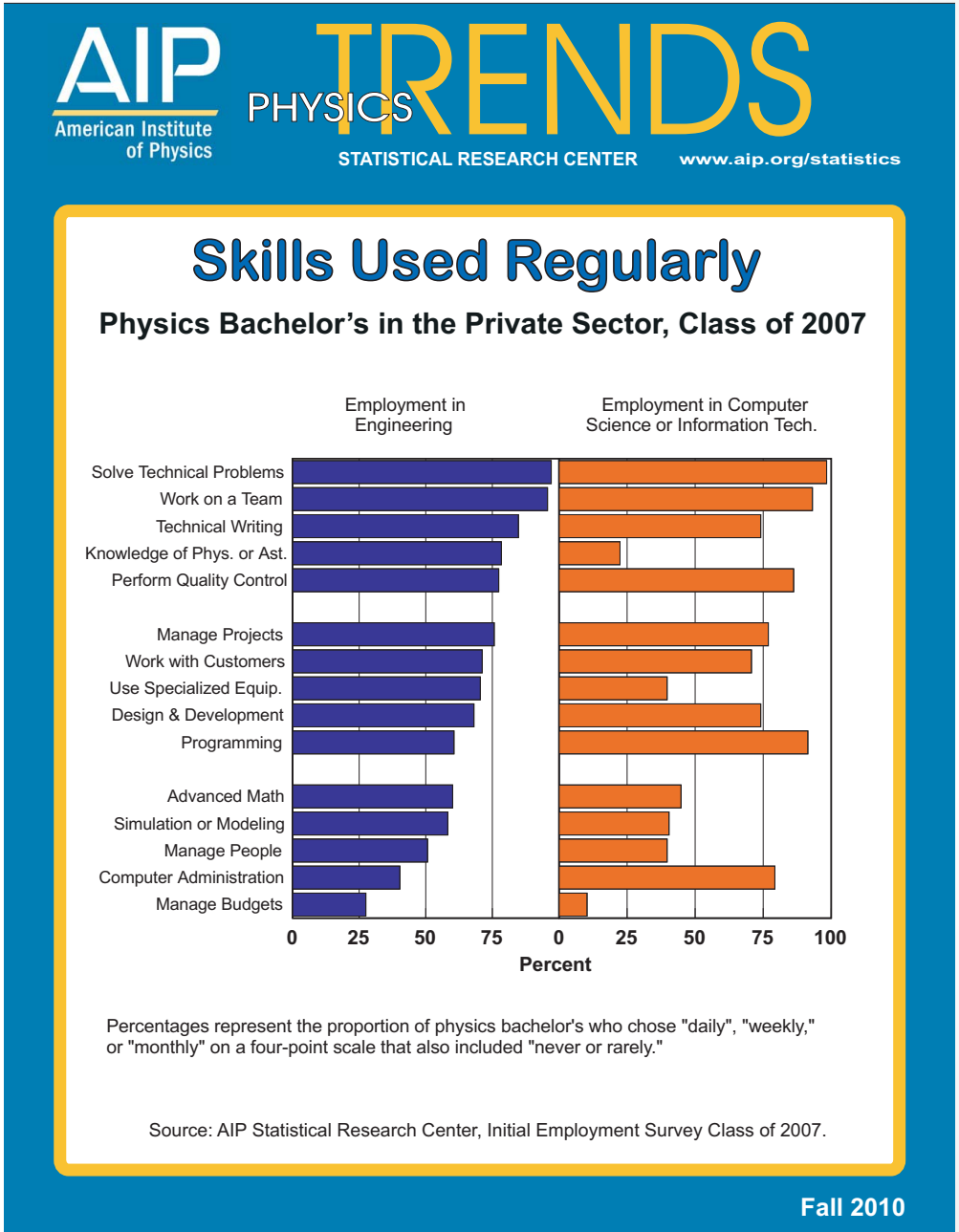
- My institution began a new assessment plan for the physics major about 18 months ago.
- This requires the assessment of the Junior Lab students':
    1. communication (written, graphical, verbal)
    2. their ability to work in a team
    3. the evaluation of a design lab

- I will share the rubrics that I have borrowed, modified, and created to implement this assessment the past two semesters.

You don't need to take notes of rubric webpages as I have printed the reference page for you to take with you.

What Items to Assess?

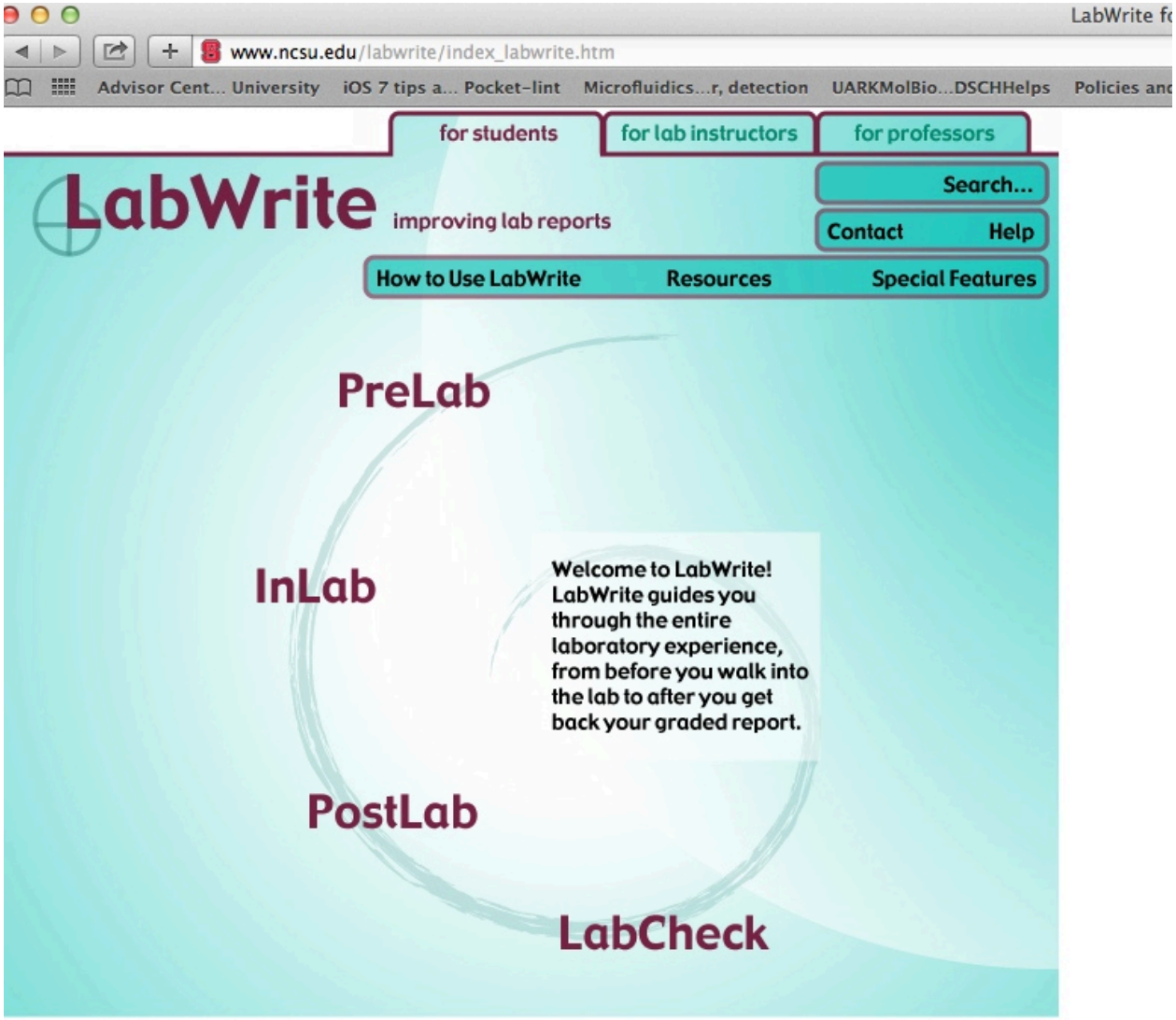
- We looked to AIP select skills to assess as these are valued by employers.[1]
- We chose more than these for our overall assessment of major…I am only talking about Jr Lab assessment today.



Skill 1. Communication

- Written communication is important in writing the abstract, introducing the research, explaining the theory behind the experiment, providing adequate details of the experimental design, describing the findings and reasons for error, and developing a coherent conclusion.
- Graphical communication involves the description and explanation of the characteristics of graphs made during an experiment. It also involves proper format of tables and integrating the findings obtained in the graph into the results of the experiment. We found our students needed more skill in describing the graph, they wanted to simply display it and go on without ever using words to describe the graph.
- Verbal communication includes speaking publically about each of the above items above in a way that reaches the audience.

LabWrite



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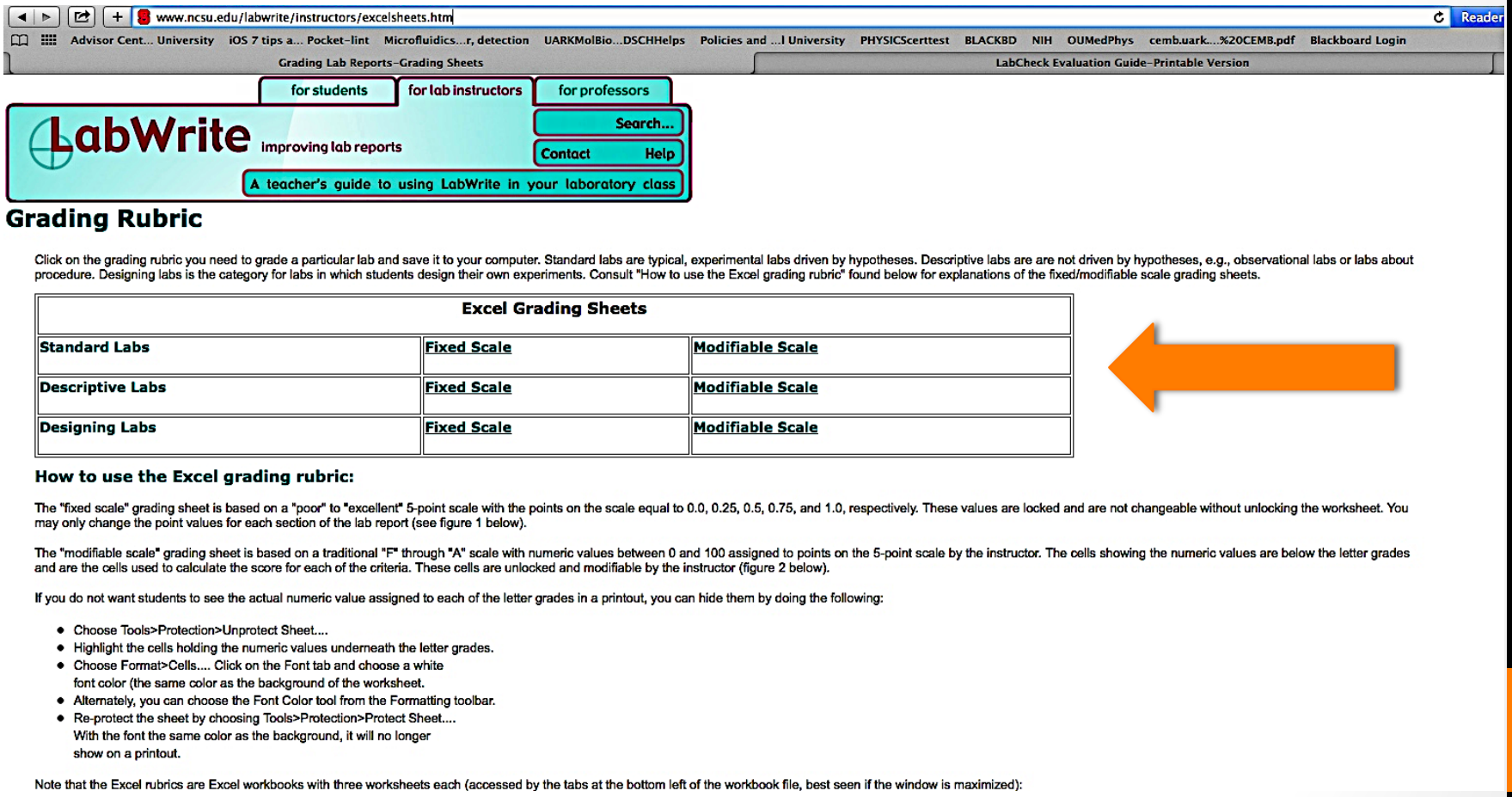
NC STATE UNIVERSITY

I have used LabWrite[2] for many years to guide my students in writing formal lab reports. I encourage your students to look at LabWrite online.

Rubrics on LabWrite

- Labwrite rubrics are on their site.



LabWrite Std Lab Excel Rubric

Thank you NCSU!

Jr Lab Report _____ Writer: _____

Lab Partners: _____, _____

Section Points		Poor F 0	D 69	C 77	B 85	Excellent A 93	Section Scores
1	**Title**						0.93
1	Describes lab content concisely, adequately, appropriately					x	0.93
4	**Abstract**						2.76
4	Conveys a sense of the full report concisely and effectively		X				2.76
10	**Introduction**						8.66
4	Successfully establishes the scientific concept of the lab				x		3.40
4	Effectively presents the objectives and purpose of the lab					x	3.72
2	States hypothesis and provides logical reasoning for it			x			1.54
10	**Methods**						9.30
10	Gives enough details to allow for replication of procedure					x	9.30
20	**Results**						18.60
5	Opens with effective statement of overall findings					x	4.65
5	Presents visuals clearly, legibly, and accurately					x	4.65
5	Presents verbal findings clearly and with sufficient support					x	4.65
5	Successfully integrates verbal and visual representations					x	4.65
20	**Discussion**						18.20
5	Opens with effective statement of support of hypothesis					x	4.65
5	Backs up statement with reference to appropriate findings					x	4.65
5	Provides sufficient and logical explanation for the statement				x		4.25
5	Sufficiently addresses other issues pertinent to lab(error)					x	4.65
15	**Conclusion**						10.35
15	Convincingly describes what has been learned in the lab this is where extension problems are graded!		x				10.35
10	**Presentation**						7.44
2	Citations and references adhere to proper format	x					0.00
4	Format of tables and figures is correct					x	3.72
2	Report is written in scientific style: clear and to the point					x	1.86
2	Grammar and spelling are correct					x	1.86
10	**Overall aims of the report:** *the student...*						9.30
2	Has successfully learned what the lab is designed to teach					x	1.86
2	Demonstrates clear and thoughtful scientific inquiry					x	1.86
6	Accurately measures and analyzes data for lab findings					x	5.58
100						**Points Earned**	**85.54**
						Total Possible Points	93
						Percentage	**92%**

Written Communication rubric results

- All but 1 student this year (9 in fall, 8 in spring) knew what I wanted on labs because they read the rubric.
- One however was not so happy on his evaluation of grading:

I loved this lab, but I had some trouble getting everything that she wanted in the lab writeups. I did improve on the next bundle of writeups, but I still had some learning to do! By the end of the course I understood what all needed to be on the writeups. But now I'm looking at a C right now, if I do good on the final I might be able to pull a B. I was a little bitter about the grading of this class, but everyone else did fantastic! I'm just dumb I guess....

- It took me about 3 hours to grade 8 or 9 students lab reports using this rubric. For me…this assessment cost me time.
- My evaluation on course was 4.6/5 (bit lower than my normal I believe because they thought the course was too much work).

Lab Scores Using Rubric

	JR Physics Lab - Dr. K. Williams F13																
	Team1	Hspect	FHz	Light	Team2	Thalf	e/m	h	Team3	VP	Gamma	Bungee	Team	PeerEval	Design	SUM	%
#	**36**	**100**	**100**	**100**	**36**	**100**	**100**	**100**	**36**	**100**	**100**	**100**	**36**	**30**	**70**	**1044**	**100**
12	36	90		91	36	94	89	97	36	90	92	96	36	30	67	**980**	**93.87**
18	33	91	89		36	98	96	94	34	85	95	95	36	30	56	**968**	**92.72**
7	26	87	59		30	96	96	79	36	90	94	93	36	30	61	**913**	**87.45**
9	30	80	94		36	88	85	80	35	93	93	93	36	30	61	**934**	**89.46**
3	35	89	91	98		98	99	0	35	88	95	90	30	30	61	**939**	**89.94**
2	32	96	95	90	36	98	96	96	36		93	93	36	30	61	**988**	**94.64**
11	33	89	96	90	32		82	86	36	78	81	95	36	30	67	**931**	**89.18**
1	31		93	81	36	92	95	94	36	89	89	95	36	30	56	**953**	**91.28**
4	36	95	97	91	36	98	98	92	36	92		95	36	30	67	**999**	**95.69**

	Junior Physics Lab -Sp14 Williams																
S#	Team1	Hspect	Light	FHz	TEAM2	e/m	t1/2	Planck	Team3	mu	T	Bungee	Team4	PeerEval	Design	SUM	%
0	**36**	**100**	**100**	**100**	**36**	**100**	**100**	**100**	**36**	**100**	**0**	**100**	**36**	**30**	**70**	**1044**	**100**
17	34.5	0	75	88	36	58	73	94	36	51	80	93	36	28	43.8	**826**	**79.15**
4	34.5	92	98	100	35	96	96	96	36	0	91	93	36	30	58.3	**992**	**95**
7	36	89	79	95	36	0	83	87	36	88	88	93	36	30	61.2	**937**	**89.77**
13	35.5	96	94	99	31	93	96	98	33	95	0	93	36	27	43.8	**970**	**92.94**
2	33.5	91	90	95	31	98	0	96	36	95	89	93	36	29	58.3	**971**	**92.99**
14	36	88	84	96	36	97	94	0	36	89	85	93	36	30	58.3	**958**	**91.79**
1	36	96	0	84	35	96	98	96	36	95	87	93	36	30	61.2	**979**	**93.79**
5	36	0	89	96	36	95	90	94	36	90	85	93	36	29	43.8	**949**	**90.88**

Graphical Communication

- I used section on Results and Presentation from the Written Comm. Labwrite rubric for graphical skill assessment for Franck Hertz lab..

20		Results						18.60
	5	Opens with effective statement of overall findings					x	4.65
	5	Presents visuals clearly, legibly, and accurately					x	4.65
	5	Presents verbal findings clearly and with sufficient support					x	4.65
	5	Successfully integrates verbal and visual representations					x	4.65

10		Presentation						7.28
	2	Citations and references adhere to proper format	x					0.00
	4	Format of tables and figures is correct					x	3.72
	2	Report is written in scientific style: clear and to the point					x	1.86
	2	Grammar and spelling are correct				x		1.70
10		Overall aims of the report: *the student...*						9.30
	2	Has successfully learned what the lab is designed to teach					x	1.86
	2	Demonstrates clear and thoughtful scientific inquiry					x	1.86
	6	Accurately measures and analyzes data for lab findings					x	5.58

Verbal Communication

- Students did a design/research project the last 2-3 wks.
- Students completed a powerpoint and gave the presentation to the class for their final exam.
- Their peers completed this sheet and the average was their verbal Comm. score. (minus item2 and 6).
- So this was a one shot measurement of verbal communication skill.

JUNIOR LAB PEER GRADING SHEETS SP2014 - DO NOT GRADE YOURSELF. .

	Strongly Agree	Agree	Disagree	Strongly Disagree	Not Apply	SUM
	5	4	2	1	3	xxxxxxxx
Can hear presentation						
Can see presentation						
Paper given professionally						
Explained well						
Research Complete						
Work Shared						
Overall Pt Score						

Skill 2: Teamwork

- Several years ago, I encountered a student that did not want to work with others. The students did not want to work with this student either.
- So…. I put the students in groups so they each had to work with this student.
- Each set of 3 labs the students worked together, then next set of 3 labs they would work with others.
- At the end of the 3 labs each student completed this rubric and turned it in to me directly.
- The teamwork rubric came from the U of Wisc/Stout[4] with few modifications.

Teamwork Rubric

person evaluated: _____ evaluator: _____

Category	Exemplary (3 pts)	Proficient (2 pts)	Somewhat proficient (1 pts)	Unsatisfactory (0 pts)	POINTS (36 pts max.)
1. Focus on the task.	Stays on task all of the time without reminders.	Stays on task most of the time. Group members can count on this person.	Stays on task some of the time. Group members must sometimes remind this person to do the work.	Hardly ever stays on task. Lets others do the work.	
2. Extent to which works together.	A true team member who works hard and helps others in the group.	A strong group member who tries hard!	Sometimes an active group member, but needs to try harder.	Sometimes chooses not to help out, and does not complete tasks.	
3. Work meeting habits.	Is on time for meetings, turns in all work when it is due.	Usually on time for meetings, turns in most work when it is due.	Sometimes late for meetings, often turns in work late.	Late for all or most meetings, and late turning in work.	
4. Completion habits.	Completes assigned tasks and does not depend on others to do the work.	Completes most assigned tasks.	Does not follow through on most tasks and sometimes counts on others to do the work	Does not complete tasks. Depends on others to do all of the work.	
5. Attitude/Behavior while Listening, Talking, Discussing	Respectfully listens, discusses, asks questions and helps direct the group in solving problems.	Respectfully listens, discusses and asks questions.	Has trouble listening with respect, and takes over discussions without letting other people have a turn.	Does not listen with respect, argues with teammates, and does not consider other ideas. Blocks group from reaching agreement.	
6. Research and Information-Sharing	Gathers information and shares useful ideas for discussions. All information fits the group's goals	Usually provides useful information and ideas for discussion.	Sometimes provides useful information and ideas for discussion.	Almost never provides useful information or ideas for discussion.	
7. Problem-solving	Actively seeks and suggests solutions to problems.	Improves on solutions suggested by other group members.	Does not offer solutions, but is willing to try solutions suggested by other group members.	Does not try to solve problems or help others solve problems.	
8. Goal completion	Works to complete all group goals.	Usually helps to complete group goals.	Occasionally helps to complete group goals.	Does not work well with others and shows no interest in completing group goals.	
9. Attitude about task.	Always has a positive attitude about the task(s) and the work of others	Usually has a positive attitude about the task(s) and the work of others.	Sometimes makes fun of the task(s) or the work of other group members.	Often makes fun of others' work and has a negative attitude.	
10. Time distribution on task.	All team members contributed equally to the finished project.	Assisted group/partner in the finished project.	Finished individual task but did not assist group/partner during the project.	Contributed little to the group effort during the project.	
11. Overall participation.	Performed all duties of assigned team role and contributed knowledge, opinions, and skills to share with the team. Always did the assigned work.	Performed nearly all duties of assigned team role and contributed knowledge, opinions, and skills to share with the team. Completed most of the assigned work.	Performed a few duties of assigned team role and contributed a small amount of knowledge, opinions, and skills to share with the team. Completed some of the assigned work.	Did not perform any duties of assigned team role and did not contribute knowledge, opinions or skills to share with the team. Relied on others to do the work.	
12. Grade from Instructor.					_____

TOTAL: _____

Rubric Modified by Dr Williams from: http://www2.uwstout.edu/content/profdev/rubrics/elemteamworkrubric.html

Assigned Design lab -Final Assessment of Teamwork

- Each individual after doing all of the 'regular labs' must be a team (consulting group) for a rather odd assigned lab.
- Each group must meet and work on a part of this project.
- All groups meet and decide how to solve the problem. The work that group A must do first is decided.
- Group A does work that day on it and then all 3 groups meet at the end of the day to decide what must be done next. All groups have input.
- The next week group B does this work. At the end they all meet and decide what group C must do.
- Then they must work together to do the final report.
- At the end they turn in the report and turn in TEAMWORK forms on each other.

Skill 3: Design Lab

- After the entire class "team" project, I make them pick something to research. 2-4 students may work together.
- They must design the lab, gather the equipment and do the experiment and write it up on a powerpoint as if they were presenting at a conference.
- The rubric I chose to assess the design of their lab was from the American Association of Colleges and Universities: The Inquiry and Analysis Value Rubric.[5]

Design Rubic

INQUIRY AND ANALYSIS VALUE RUBRIC

for more information, please contact value@aacu.org

Association of American Colleges and Universities

Definition

Inquiry is the ability to know when there is a need for information, to be able to identify, locate, evaluate, and effectively and responsibly use and share that information for the problem at hand. – The National Forum on Information Literacy

Evaluators are encouraged to assign a zero to any work sample or collection of work that does not meet benchmark (cell one) level performance.

	Capstone 4	Milestones 3	Milestones 2	Benchmark 1
Topic selection	Identifies a creative, focused, and manageable topic that addresses potentially significant yet previously less-explored aspects of the topic.	Identifies a focused and manageable/doable topic that appropriately addresses relevant aspects of the topic.	Identifies a topic that while manageable/doable, is too narrowly focused and leaves out relevant aspects of the topic.	Identifies a topic that is far too general and wide-ranging as to be manageable and doable.
Existing Knowledge, Research, and/or Views	Synthesizes in-depth information from relevant sources representing various points of view/approaches.	Presents in-depth information from relevant sources representing various points of view/approaches.	Presents information from relevant sources representing limited points of view/approaches.	Presents information from irrelevant sources representing limited points of view/approaches.
Design Process	All elements of the methodology or theoretical framework are skillfully developed. Appropriate methodology or theoretical frameworks may be synthesized from across disciplines or from relevant subdisciplines.	Critical elements of the methodology or theoretical framework are appropriately developed, however, more subtle elements are ignored or unaccounted for.	Critical elements of the methodology or theoretical framework are missing, incorrectly developed, or unfocused.	Inquiry design demonstrates a misunderstanding of the methodology or theoretical framework.
Analysis	Organizes and synthesizes evidence to reveal insightful patterns, differences, or similarities related to focus.	Organizes evidence to reveal important patterns, differences, or similarities related to focus.	Organizes evidence, but the organization is not effective in revealing important patterns, differences, or similarities.	Lists evidence, but it is not organized and/or is unrelated to focus.
Conclusions	States a conclusion that is a logical extrapolation from the inquiry findings.	States a conclusion focused solely on the inquiry findings. The conclusion arises specifically from and responds specifically to the inquiry findings.	States a general conclusion that, because it is so general, also applies beyond the scope of the inquiry findings.	States an ambiguous, illogical, or unsupportable conclusion from inquiry findings.
Limitations and Implications	Insightfully discusses in detail relevant and supported limitations and implications.	Discusses relevant and supported limitations and implications.	Presents relevant and supported limitations and implications.	Presents limitations and implications, but they are possibly irrelevant and unsupported.

I complete this on each group for their Design grade worth 70 pts.
Their score on the verbal assessment is 30 pts of their final 100.

Jr Lab Assessment Conclusions

- Doing all this assessment in only one lab is probably not optimal. It should be used in all upper level labs.
- Teaching Jr Lab both semesters to 9 and 8 students was a great deal of work using the rubrics while teaching a load of 4-5 other courses. I feel we do have a good assessment and the administration seems happy.
- I do feel nearly all students know how to write research quality papers as a result. Some did present research after more work.
- Perhaps one day I will merge several of these rubrics into one better one.
- The students do see the write-ups as less 'objective' with the lab rubric, much much less arguing for more points as they can see what they are missing with my comments and the lab rubric.

Information

- I have printed my references for the rubrics if you would like to take one.

- My contact info is kwillims@mac.com (no ‘a’)

  or kwilliams@ecok.edu

Thank you!

References

1. http://aip.org/statistics/physics-trends/skills-used-regularly
2. http://www.ncsu.edu/labwrite/index_labwrite.htm
3. http://www.ncsu.edu/labwrite/instructors/excelsheets.htm
4. http://www2.uwstout.edu/content/profdev/rubrics/elemteamworkrubric.html
5. http://bloomu.edu/documents/middlestates/monitoringreport/MSRpt/E_26.pdf