

Laboratory Report Grading Rubrics: What High School Teachers are Doing

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Introduction

According to Heidi Goodrich a rubric is “a scoring tool that lists the criteria for a piece of work or ‘what counts.’”¹ Rubrics can be used to evaluate any type of student work, including oral presentations, written reports, and web pages. Carl Wenning of Illinois State University expands the definition of rubrics by explaining, “Rubric grading is criterion based. That is, the rubric contains criteria for acceptable performance that are meaningful, clear, concise, unambiguous, and credible -- thus ensuring interrater (sic) reliability.”²

There are many advantages for the instructor who uses rubrics to grade student work. For many instructors, probably the first reason to use a rubric is that it speeds up the grading process. When what will be evaluated and what each element is worth is predetermined, less time is spent contemplating the "right" grade to put down. The use of rubrics insures consistency. For example, suppose an instructor finds an exceptionally good report in the middle of the stack s/he is grading. The report next in the stack is not as good, and therefore does not deserve as good of grade. But it might get a lower grade than it would if it had appeared earlier in the stack. (The old saying "That's a hard act to follow!" comes to mind.) If rubrics are in use, the instructor will apply the same criteria to every student's work.

But there are more advantages to rubrics than helping with the grading process. If students receive a copy of the grading rubrics before completing the assignment, they will get better grades because they will know what the teacher is looking for and what is important. If rubrics are developed very early in the creation of an assignment, they will go hand-in-hand with the objectives - each will help better define the other. For instance, if an instructor knows that the conclusions will be worth a substantial part of the grade, then delivering a good conclusion should be a stated objective for the assignment.

Example Lab Report Rubrics: Simple, Complete, and Creative

Figures 1-4 show rubrics from four high school teachers. The Figure 1 shows a general science rubric. Each level has a detailed description of the criteria for performance at this level. Note that there is an even number of “Levels” – this is recommended to prevent too many “middle” responses. Point values are assigned for each level; the final grade is a total of all points earned.

Figure 2 is a chemistry lab report rubric developed as part of a “Writing Across the Curriculum” project. It examines in detail the content and format of the report, including requirements for specific data and font size. The rubric in Figure 3 gives even more detail. It

	LEVEL 1 (5.0)	LEVEL 2 (6.0)	LEVEL 3 (7.0 - 8.5)	LEVEL 4 (10.0)
ORGANIZATION	some attempt made to put things in order with obvious errors and/or omissions	some error made in placement of headings or statements	organized with considerable competence	contains all necessary headings in correct order and headings are clearly distinct from statements
'TITLE' TO 'METHOD'	some attempt made to report some kind of statements for at least some areas	some omissions may have been made on key statements	key statements are present with very little error or omission	excellent and complete details put into all areas and complete sentences used
'DATA', 'OBSERVATIONS' AND 'CALCULATIONS'	some attempt made at recording data, observations and/or calculations	contains many good statements, and an attempt is made to perform calculations, with some error or omission	contains most key statements and calculations with very little error or omission	clear, precise details given in full sentences with no errors or omissions, and all calculations performed accurately
'CONCLUSION'	a vague attempt made at a conclusion	concluding statement made with error or omission	good concluding statements made which supports or disproves the hypothesis	excellent, precise detail given in full concluding sentences which clearly support or disprove the hypothesis
NEATNESS & OVERALL IMPRESSION	messy writing, with statements placed haphazardly, which seems to support little effort or care taken in its preparation	somewhat neat with some effort and care taken in its preparation	very neat and well organized, headings and statements placed properly	extremely neat and well organized, all headings and statements properly placed, use of colour and/or underlining OR typed with use of bolding, underlining and/or colour

**some labs may not have data and/or calculations, in which case ignore those areas in the rubric

Figure 1:Generic Science Lab Report Rubric³

was developed for an honors biology class. The finely delineated criteria include specifics about format, content, and results.

Figure 4 is the most creative report rubric. It appeared in a magazine for Indiana science teachers. The author Richard Emery (who teaches AP Chemistry) explains how enthused his students became when he required artwork on the front cover of each lab report. He would then display the reports around the door to his classroom. This rubric indicates that the teacher is more interested the front cover art than any other aspect of the lab report. Emery states in his article, "As with any project, there will always be one or two students that go far beyond what is expected. This year, I have two students who not only have cover pages of 'door' quality but every page of their reports is 'door' quality."

The rubrics documented here show a wide variety of criteria to evaluate student work. The first evaluates each required section of the report, using qualitative guidelines. The second and third examples give more detail not only about the report structure, but also evaluate the report content. The fourth example places the most emphasis (and detailed criteria) on the report cover. A full 60% of the grade is based on artwork and neatness – not on content.

Impact on College Instructors

The students entering freshman college labs come from a variety of backgrounds regarding expectations for a lab report. Some freshman will recognize the importance of

I.	Purpose: Clearly stated _____ / 5 Correct purpose
II.	Procedure: Materials list _____ / 2 Concise, short steps _____ / 2
III.	Observations & Data: Observation sheet neat, in ink _____ / 3 Observations descriptive & concise _____ / 3 Mass taken before & after reaction _____ / 2 Balanced formula _____ / 3 Theoretical yield computed correctly _____ / 3 Percentage yield computed correctly _____ / 2
IV.	Conclusion Grammatically correct _____ / 10 Ties together lab data and observations Explains data with valid explanation Describes difference between theoretical & actual yield Discussion on error and reasons for a low percentage yield
Other: Typed with proper spacing _____ / 5 Correct lab format Proper heading 10 to 12 point font size used Total: _____ / 40 Teacher comments:	
Figure 2: Chemistry Grading Rubric ⁴	

completeness, while others will emphasize neatness. “A” work in one high school may be “D” work in another. This wide range of backgrounds makes it imperative that college lab instructors develop lab report rubrics and share them with their students, if students are to succeed in writing acceptable reports.

Obviously, individual college instructors will have different criteria for grading reports. The examples included in this paper may give some ideas on what to include. Wenning explains that a rubric is only used to assess observable behavior. He suggests creating scoring guides with the following elements²:

- fully explicit scoring criteria
- examples or models illustrating each score point
- an abbreviated one-page version of the

Lab Report Grade Sheet
Style: (5pts) Typed Times New Roman, 12 pt font 1.5 spacing Default margins
Title: (2pts) Present Descriptive
Problem: (2pts) Stated as a question
Hypothesis: (3pts) Present Well stated Testable
Materials: Complete (3) Listed (1)
Procedure: Numbered steps (1) Complete (2) Easy to follow by others (2)
Identification of experiment: Control group identified (1) Experimental group identified (1) Standard conditions identified (1) Independent variable identified (1) Dependent variable identified (1) Special conditions identified (1)
Data: Organized (2) Complete (2) Calculations shown (1) Graphs/tables correctly labeled (5) Free of opinion (2) Goes beyond the norm (+3)
Analysis and Conclusion: Detailed analysis of data. (3) Refers back to original problem (1) Restates original hypothesis (2) Identifies support for or against hypothesis (2) Identifies at least three sources of error (3) Goes beyond the norm (+3)
Grammar & Spelling: Multiple misspelled words (-3) Multiple grammatical errors (-3)
Figure 3: Biology Lab Report Rubric ⁵

criteria for reference during actual rating

<p><u>Grading Rubric</u> 40% Cover Page: 10% Follows theme 10% Imagination 10% Neatness 10% Use of Color</p> <p>20% Five Aspects of a Lab Report: Purpose Materials Procedure Data and Calculations Conclusion</p> <p>20% Neatness (no erasures, no correction fluid)</p> <p>20% Correctness (answer)</p>

Figure 4: Creative Chemistry Rubric⁶

- a form for recording scores

Rubistar¹ has a “wizard” to help with the creation of rubrics, including one for lab reports. It allows a teacher to select from 21 categories complete with descriptions of performance levels. Example categories are shown in Table 1. Unique to this list (compared to others in this paper) are the categories of participation and scientific concepts.

Another important consideration of these rubrics is that *they are mainly used to grade the report, not the lab assignment*. For instance, using the rubric in Figure 4, a

CATEGORY	4	3	2	1
Spelling, Punctuation and Grammar	One or fewer errors in spelling, punctuation and grammar in the report.	Two or three errors in spelling, punctuation and grammar in the report.	Four errors in spelling, punctuation and grammar in the report.	More than 4 errors in spelling, punctuation and grammar in the report.
Drawings/ Diagrams	Clear, accurate diagrams are included and make the experiment easier to understand. Diagrams are labeled neatly and accurately.	Diagrams are included and are labeled neatly and accurately.	Diagrams are included and are labeled.	Needed diagrams are missing OR are missing important labels.
Participation	Used time well in lab and focused attention on the experiment.	Used time pretty well. Stayed focused on the experiment most of the time.	Did the lab but did not appear very interested. Focus was lost on several occasions.	Participation was minimal OR student was hostile about participating.
Calculations	All calculations are shown and the results are correct and labeled appropriately.	Some calculations are shown and the results are correct and labeled appropriately.	Some calculations are shown and the results are labeled appropriately.	No calculations are shown OR results are inaccurate or mislabeled.
Conclusion	Conclusion includes whether the findings supported the hypothesis, possible sources of error, and what was learned from the experiment.	Conclusion includes whether the findings supported the hypothesis and what was learned from the experiment.	Conclusion includes what was learned from the experiment.	No conclusion was included in the report OR shows little effort and reflection.
Scientific Concepts	Report illustrates an accurate and thorough understanding of scientific concepts underlying the lab.	Report illustrates an accurate understanding of most scientific concepts underlying the lab.	Report illustrates a limited understanding of scientific concepts underlying the lab.	Report illustrates inaccurate understanding of scientific concepts underlying the lab.

Table 1: Other possible criteria

student could get a 70% *without performing the experiment*. If the instructor is more interested in the lab report as a writing assignment, this may be acceptable. If, on the other hand, an instructor wants to evaluate student laboratory results or skills, the rubric will need to include criteria such as the accuracy of the data and results, illustration of scientific concepts, and

additional weighting on the content of the conclusion. The participation category (though not easy to assess from the lab report itself) evaluates yet another aspect of the lab experience.

Figure 5 shows a simple 10 point rubric that can be used for freshman level weekly laboratories. In this example, 30% of the grade is based on the pre-laboratory assignment – one way to encourage students to come to lab prepared is to include completion of the pre-lab in the rubric. If other “issues” arise in a course, criteria can be modified to meet them.

Conclusion

High school teachers are using grading rubrics for a wide variety of assignments. Not only do they speed up the grading process, but also effectively communicate to students what is expected, and aid in the definition of assignment objectives. College instructors must be aware that

rubrics vary radically between high schools. What one teacher values greatly may be of little or no importance to another. Students’ experiences and expectations are going to vary as least as much, if not more, than the rubrics presented in this paper. All these factors combine to make it important for college instructors to have rubrics for their own students.

As mentioned above, rubrics bring the assignment’s objectives into focus. If the assignment has a major written communication emphasis (ABET criteria G), then the rubric will have more criterion that evaluate writing. If the emphasis is on knowledge of the discipline, applications of that knowledge, experimental processes, or creativity in design (ABET criterion A-D), then the rubric should contain criterion to evaluate the student’s lab implementation, results and conclusions.

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1. High Plains Regional Technology in Education Consortium (2001). “Rubistar: Create Rubrics for your Project-Based-Learning Activities”. Retrieved January 6, 2002 from <http://rubistar.4teachers.org/>
2. Wenning, Carl J. (2001). *Creation of Grading Rubrics*. Retrieved January 6, 2002 from <http://www.phy.ilstu.edu/ptefiles/311content/assessment/rubrics.html>
3. Chase, D. (2001). *Science Shares: A Collection of Ideas and Suggestions from the Science Teachers of the Limestone District School Board*. Retrieved January 6, 2002 from <http://www.limestone.on.ca/SSR/science.html>

EET 154 Lab Grade Rubric	
Prelab complete on-time	_____ / 3
All sections in report (e.g. Objective, Equipment, Procedure, schematics, ect.) & well presented	_____ / 2
Data and Results complete, correct and accurate	_____ / 3
Conclusions: Answer any questions, contain insightful ideas	_____ / 2
Grade:	_____ / 10

Figure 5: Simple Freshman Laboratory Rubric

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6. Emery, H. Richard (2000). *Why My Students Love Lab Reports!* *The Hoosier Science Teacher*. Volume XXVI, Number 1.

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