Sample Assessment Rubric

Introduction

Development of rubrics as a template for identifying performance criteria has been shown to increase student achievement. A typical rubric clearly denotes each category to be evaluated and provides specific, required criteria for defining excellence, proficiency, and below-proficiency levels of performance. The sample rubrics for each chapter are intended to serve as guidelines. It should be understood that assessment is more effective when students and teachers tailor it to fit their needs. You are encouraged to work with your colleagues and especially with students to customize the rubric and the criteria. Decisions should be made together with respect to the curricular goals of the project within the particular context. For example, a class may choose to add one requirement in lieu of another, or to change the relative weighting of categories. It is helpful to remember the following recommendations:

1. Assessment should directly address the goals of the *Chapter Challenge*.

   Attention has been paid to the suggested rubrics in addressing the goals of the chapter, and the *Physics You Learned* section should serve as a guide for students and teachers working with the challenge. You may choose to make changes to the rubric in order to emphasize goals important to their context.

2. Students should participate in the assessment of their own performance.

   Students submit their rubric along with the grade they have given themselves. This not only encourages students to take ownership of the project, but it becomes a useful assessment tool for the teacher. If a student earns a "C" and gives himself or herself a "C," the conversation is very different than if a student were to earn a "C" and give himself or herself an "A." The question you might have for the first student is, "Why didn't you choose to do more?" While you might need to review the criteria with the second student and help understand what it takes to get an "A." After the teacher has graded the assignment, students have an opportunity to revise their work, and resubmit it for the "revision" grade. Emphasis should be placed not only on the finished project, but on progress with the rubric during revision.

3. Assessment should begin from a foundation of a proficient level of performance, providing ladders for students to achieve higher orders of thinking.

Finally, the rubric is built from a foundation of proficiency (meets standards). An analogy for this level is that in the real world their is a minimum acceptable standard for performance. A CD must play without skipping, and a shirt must have all of its buttons. Anything less, is substandard. This rubric works the same way. To get a "C" or better, the work must meet all the standards, and fall into the "proficient" category. Work not meeting all standards must be revised and resubmitted. Beyond proficiency, students can do work which shows mastery and may therefore earn a "good" or "excellent" rating (a "B" or an "A"). The scoring column of the rubric includes suggested point ranges for each level of mastery.

For further discussion, see: "Assessment of Laboratory Investigations," Eisenkraft, Arthur and Anthes-Washburn, Matthew. "Assessment: Research and Practical Approaches," eds. Coffey, Douglas and Stearns. NSTA Press 2008.

Guide to the Sample Assessment Rubric

Assessment via this rubric will assign students to one of three major groups:

Excellent: Work meets all standards and demonstrates extensive evidence of mastery.

Good: Work meets all standards and demonstrates moderate evidence of mastery.

Proficient: Work meets standards without further evidence of mastery.

Please note that these groups are written at the top of the rubric page as a reminder to students.

In the table, there are three main groups of criteria—Mastery, Meets Standards, and Interventions. A student or team of students should achieve all of the criteria in order to satisfactorily complete the project. Anything less than this will require that the student make another attempt using the Interventions listed in the last column. This is the foundation, or floor of expectations. As teachers, we have to beware that our floor of expectations does not become a ceiling for some students.

1. In the first column, there are suggestions for demonstrating mastery. Completing one or more of these may raise a student or team from Proficient, to Good or Excellent.
2. In the second column, the criteria to meet the standards for the assignment are listed.
3. Some students may have trouble meeting the standards in the Meeting Standards column. The last column provides Interventions, or suggestions for how a student might meet the requirements of the project.
4. In the Scoring column, students submit their own grade, and you respond with a grade and feedback. Students receive a final grade after a revision is submitted. The range of scores for Excellent, Good, and Proficient allow you to assign points that match a student or team's demonstrated mastery. Thus, a student who barely meets standards can receive a different score than one who shows a higher level of mastery.

Implementing the Sample Assessment Rubric

- Modify the rubric with discussions from students.
- Hand out the rubric.
- Review the rubric so that you are confident that students understand each component.
- Have students complete the Scoring column for their work in the chapter by placing checks in each of the boxes. Have students assign themselves a point value for each component.
- Have students total their score for the rubric.
- Collect the student self-appraisal of their work.
- Use the rubric to grade the student work.
- Grade students' work after you and the student agree on the grade. Encourage the student to improve their work for the next chapter. If you and a student disagree, have an appropriate conversation with the student about his or her work and how it could be improved.

The *Sample Assessment Rubric* on the following page is provided as a *Blackline Master* on your *Teacher Resources CD*.

4c **Blackline Master**

Sample Assessment Rubric

Mastery (Students may show mastery through these or other ideas provided by students and teachers.)	**Meets Standards**	**Scoring** (To be discussed by students and teacher)	**Interventions** (Guiding questions and instructions for students falling short of the Standards)
• Build a scale model of the coaster. • Use modeling software to design coaster, such as the "No Limits" application.	**1. Quality of Roller-Coaster Model and Appeal to the Group of Riders Selected** • Include at least two hills, one vertical loop, and one horizontal loop in the design of the roller coaster. • Create an original and unique design.	**Maximum:** 30 Points ***Excellent:** 27–30 **Good:** 24–26 **Proficient:** 21–23 *Student Self Grade:* *Teacher Grade:* *Revision:*	• How do different shapes and turns compare in the level of thrill? • Can you change the passenger position, car design, or track design to make the ride more thrilling?
• Explain: How would you double the maximum velocity safely? (Remember, safe acceleration < 4 *g*) • Explain: What would happen if a loop in the roller coaster were a circular, instead of a clothoid shape?	**2. Safety of the Roller Coaster** • Calculate the height, speed, and acceleration of the roller coaster at five designated locations. • Make calculations correctly (where appropriate). • Use scientific terminology correctly, including speed, velocity, acceleration, and centripetal force. • Use scientific symbols for units and equations appropriately with correct symbols. – Numerical calculations are accurate. – Correct units are used in determining safety data. – Safety data indicate that the roller coaster is safe.	**Maximum:** 20 Points ***Excellent:** 18–20 **Good:** 16–17 **Proficient:** 14–15 *Student Self Grade:* *Teacher Grade:* *Revision:*	• Which point will have the maximum height? Speed? Acceleration? • What variable is most important to maintaining the safety of the roller coaster? Why?
• Discuss quantitatively: How can you get more thrills for the same amount of energy? • Discuss quantitatively: What are the characteristics of the emergency spring system? Over how much distance will it work? What is the acceleration experienced by the car and passengers?	**3. Calculation of Energy and Power** • Calculate the energy and power required to get the roller coaster rolling, the energy dissipated at the end of the ride to bring the roller coaster to a halt, and the characteristics of a spring system to stop the roller-coaster cars in case the brakes fail • Make calculations correctly (where appropriate) • Correctly use scientific terminology, including gravitational potential energy, kinetic energy, spring potential energy and power. • Use scientific symbols for units and equations correctly.	**Maximum:** 20 Points ***Excellent:** 18–20 **Good:** 16–17 **Proficient:** 14–15 *Student Self Grade:* *Teacher Grade:* *Revision:*	• How is energy transformed in your roller coaster? • How is energy added to the system? How is it removed at the end? • Where does the energy go?

• Use expert information from outside sources to enhance the analysis of their design and cites them as instructed by the teacher. • Describe the needs and wishes of the selected group of riders and the design considerations to be made for the group.	**4. Quality of Written Report or Poster** • Identify and describe the selected group of riders. • Use tables and graphs where appropriate. • Organize the report so it is easy to follow and understand. • Use correct sentence structure. • Use correct spelling, punctuation, and grammar. • Use the correct number of pages (determined by class and teacher). Suggested: 2-3 pages double-spaced.	**Maximum:** 30 Points ***Excellent:** 27–30 **Good:** 24–26 **Proficient:** 21–23 *Student Self Grade:* *Teacher Grade:* *Revision:*	• Use suggestions from your teacher to improve your written report or poster. • For whom is the coaster designed? • Try using headings to organize the elements of your report. • Have someone read your work and circle parts that are confusing, or sound awkward. Then go back and try to reword or reorganize those parts.
		TOTAL: ***Excellent:** 90–100 **Good:** 80–89 **Proficient:** 70-79	

* **Excellent:** Work meets all standards and demonstrates extensive evidence of mastery.
Good: Work meets all standards and demonstrates moderate evidence of mastery.
Proficient: Work meets standards without further evidence of mastery.

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