Design Your Own Rubric

by Julie Luft

Day in and day out science educators struggle with assessment. They frequently assess students on their content knowledge, their participation in the process of science, or their understanding of the nature of science. The information gathered is often significant in measuring a student’s attentiveness to classroom instruction, but the information does not provide a mechanism for the student to improve his or her performance.¹

Hodson suggests that science educators should use assessments that are summative, formative, evaluative, and educative (Figure 1).² Using these four kinds of assessment, science educators can determine a student’s current level of achievement, diagnose a student’s strengths and weaknesses, evaluate curriculum effectiveness, and allow a student to learn how they know and understand science.

Rubrics are scoring criteria that can fit Hodson’s suggestions. In the classroom, they can make assessment more meaningful, clarify expectations, and yield better feedback.³ Specifically, rubrics are constructs or matrixes that define what is expected in a learning situation. They can be used to assess any aspect of science classroom work: practical work, a science project, a portfolio, or a lab report.

Types of rubrics

There are two predominant types of rubrics: holistic rubrics and analytical rubrics. Holistic rubrics are constructs that contain different levels of performance that describe the quality, quantity, or quantity/quality of a task (Figure 2). This type of rubric requires that the assessor determine which level is the “best fit” for the student’s project, investigation, or assignment. For example, a student’s project may better fit the description that accompanies a score of 3 than a score of 2, although it contains qualities of both. Holistic rubrics are not just limited to numerical values; they can also be used to describe letter grades for the semester or levels of performance on certain tasks (Excels, Exceeds, Just Meets, or Not Yet).

Analytical rubrics are constructs that consist of criteria that are subdivided into different levels of performance. Typically, each row begins with a cell that states the criteria to be assessed and each adjacent cell describes a different level of performance for that criteria (Figure 3). To increase the clarity of an analytical rubric, each criteria topic can be subdivided into more concise statements and then followed by the related performance descriptions (Figure 4). If the descriptions at the different levels of performance are in need of further clarification, specific examples can be provided.

Prior to constructing a rubric, and once it is constructed, it is helpful to look at other rubrics. State Departments of Education, large-scale testing organizations, conventions, and educational organizations are sources for sample rubrics. Examining other rubrics will help any rubric creator develop a highly personalized assessment. Ultimately, the rubric constructed will be a statement about the goals, objectives, and expectations found within a science class.

Constructing a rubric

To construct rubrics for your class(es), either holistic or analytical, there are four steps you can follow to guide the process. These steps will assist you in constructing a first rubric or refining a current rubric.

1. Know goals for instruction

Prior to any instruction a science educator should ask, “What are the goals for my planned instruction?” Students developing critical-thinking skills, having knowl-

Julie Luft is an assistant professor at the University of Arizona in Tucson.
edge of a content area, understanding the nature of science, using a specific skill, or demonstrating cooperative-learning skills are some frequently stated goals. It is easy to have an overwhelming number of goals, so it is best to focus on the most important ones.
2. Decide on the structure of the rubric
Selecting a rubric type is directly related to how the rubric will be used in class. A rubric may be used in addition to other types of assessments or the rubric may be the only assessment. Considering the whole assessment picture is also important when deciding how to construct the levels of performance in the rubric.

In either a holistic or analytical rubric there are different levels of performance. A teacher needs to decide whether to assign these levels points or statements. Points or statements should represent a scale, for example “1, 2, 3, 4, 5” or “1, 3, 5, 7, 9” or “Excellent, Exceeds, Acceptable, Needs Improvement, No Attempt.” If there are areas that take additional time or are of special importance, these can be weighted to have more value. For example, if the teacher knows that students will spend a majority of class time doing the investigation portion of the lab, the teacher can increase the weight of the lab portion of the rubric to 3.
3. Determine the levels of performance
In a holistic rubric the stated goals will comprise each descriptive level. A science educator decides which performances constitute each level of achievement. These decisions can be based on the complexity of the each item, the impor-

### Figure 1. Hodson's assessments

<table>
<thead>
<tr>
<th>Summative assessments</th>
<th>Provides information to the teacher about the knowledge students have acquired</th>
</tr>
</thead>
<tbody>
<tr>
<td>Formative assessments</td>
<td>Enables a teacher to diagnose students’ strengths and weaknesses, the learning gains students have made, and the misconceptions that students hold</td>
</tr>
<tr>
<td>Evaluative assessments</td>
<td>Provides a teacher with information about the effectiveness of the curriculum</td>
</tr>
<tr>
<td>Educative assessments</td>
<td>Enhances and promotes students’ learning by allowing them to know how they understand science</td>
</tr>
</tbody>
</table>

### Figure 2. Holistic rubric

<table>
<thead>
<tr>
<th>A score of 3—Proficient</th>
<th>The student’s project has a hypothesis, a procedure, collected data, and analyzed results. The project is thorough and the findings are in agreement with the data collected. There are minor inaccuracies that do not affect the quality of the project.</th>
</tr>
</thead>
<tbody>
<tr>
<td>A score of 2—Adequate</td>
<td>The student’s project may have a hypothesis, a procedure, collected data, and analyzed results. The project is not as thorough as it could be; there are a few overlooked areas. The project has a few inaccuracies that affect the quality of the project.</td>
</tr>
<tr>
<td>A score of 1—Limited</td>
<td>The student’s project may have a hypothesis, a procedure, collected data, and analyzed results. The project has several inaccuracies that affect the quality of the project.</td>
</tr>
</tbody>
</table>

### Figure 3. Analytical rubric

<table>
<thead>
<tr>
<th>Criteria</th>
<th>4 points</th>
<th>3 points</th>
<th>2 points</th>
<th>1 point</th>
</tr>
</thead>
<tbody>
<tr>
<td>Demonstrates understanding</td>
<td>Complete understanding of the topic. Able to apply the topic to several different areas.</td>
<td>Understanding of the topic. Able to apply the topic to several areas.</td>
<td>Some understanding of the topic. Able to apply the topic to a limited number of areas.</td>
<td>Poor understanding of the topic. Able to recite the topic and can make a few or no applications.</td>
</tr>
<tr>
<td>Use of resources</td>
<td>Uses common and unique resources to find information.</td>
<td>Uses multiple resources to find information.</td>
<td>Uses few resources beyond readily available information.</td>
<td>Uses only resources that are readily available.</td>
</tr>
</tbody>
</table>
Rubrics are not meant to be presented at the end of a unit or project. Students should have an opportunity to see and discuss the rubric prior to the performance or science activity that is going to be assessed. This clarifies the expectations for the student and assists a teacher in guiding the student. Most importantly, it provides a guideline for students to reflect on during their work.

Benefits of rubrics in the classroom
Rubrics help clarify science learning experiences. For the teacher, a rubric provides insight into instructional objectives that guide the class. For the student, the rubric clarifies the often mysterious grade at the end of a unit or project by giving insight and direction about what is important during science.

When rubrics are shared with parents or administrators, they become powerful statements about your expectations in the classroom. Because rubrics are naturally embedded in the instructional process, they often represent the entire process and not just the end product. This allows teachers to extend assessment beyond a summative state. Rubrics can provide information about a student’s strengths and weaknesses (formative), ways to create instruction that better fits each student’s needs (evaluative), and provide students with an understanding of how they learn science (educative).

References