EFFECTIVE RUBRIC DESIGN

Making the most of this powerful assessment tool

RUBRICS CAN BE BOTH CHALLENGING and rewarding tools for assessing student performance. Rubrics need to be designed to direct the teacher and the student to the outcome in language that the student can understand. This article presents examples of one rubric style and different ways that rubrics can be used. The vehicle through which rubrics are discussed is an authentic assessment designed to develop students' understanding of how energy moves through the atmosphere.

ELECTRIFYING ASSESSMENTS

There are many methods to teach about energy depending on the course outcome desired by the teacher and/or student. In my district, we cover kinetic and potential energy in the eighth grade, leaving the transformation of energy for the ninth grade.

First, we discuss how the six different types of energy are converted from one to another. I use the generation of electricity as the method to show these transformations. Second, I use a simple distillation lab to model how heat energy and mechanical energy undergo transformations to bring the energy into and out of the atmosphere. Third, after an in-depth discussion of how the movement of energy through the atmosphere forms thunderstorms and some phenomena associated with them, the students write a creative story describing this process. All three of these items are assessed according to the standards and rubrics designed by my district.

BY KEN JENSEN

The first assessment is a writing assignment. Students design a narrative about the energy transformations necessary to make the television in our classroom work. They are assessed on two criteria. First, they must communicate the information in such a way that a wide variety of audiences could understand and benefit from what is written. Second, they must submit a product that is clear, coherent, and accurate; one that displays quality and craftsmanship. Figure 1 lists the task and rubric for the first assessment.

The second assessment is a lab experiment. Students are assigned lab groups and given the task of designing an experiment using the equipment provided. The experiment must answer the question: Will all the water evaporated out of the flask end up in the beaker?

A formal lab write-up is required that expresses all parts of the scientific method. After the lab is completed, each student must explain how energy moves through the system. The students are assessed on three criteria. First, they need to demonstrate appropriate collaborative skills during the experiment. Second, they must demonstrate proficient use of the scientific method. Third, they must analyze each part of the system and explain how energy moves through it. Figure 2 presents the task, rubric, and lab setup in detail.

The third assessment is a creative writing assignment. Students are required to write a story that describes the many different phenomena that occur during a thunderstorm. They must express how heat energy is gained and lost to account for the formation of lightning, thunder, hail, and tornadoes. The students are assessed on two criteria. First, they make comparisons between the distillation lab, the movement of energy through the

atmosphere, and the use of that energy to make thunderstorms. Second, they create a literary project that is fun and pleasing to the reader. Figure 3 lists the task, rubric, and sample diagram for the third assessment.

These multiple assessments provide a strong body of evidence to account for a thorough grasp of the Earth as a heat engine. Obvious topics such as the Earth's internal heat, as well as movement of energy in the oceans, are beyond the scope of these assessments, but could be incorporated as further bodies of evidence.

RUBRIC GRADING

Rubrics can be graded in many different ways. Some evaluators assign points to each category so that the total possible points for the rubric is 100. A percentage is based on the student's performance and the grade is added to the other grades. Other evaluators prefer to assign letter values to the rubric grades: a 4 is the same as an A, 3 equals a B, 2 equals a C, and 1 is failing. One caution about using this method is to make sure that the rubric is written in such a way that 4, 3, and 2 grades represent adequate performance on the task.

Still others design their assessments to follow a pass/fail criteria. In this case, a student passes each topic of the rubric at the specified level in order to pass the course; however, the assessment is not averaged into the student's grade. Students are usually given several chances to fulfill the criteria that they did not pass the first time. Each teacher needs to use a rubric that will best fit the needs of the class and the assessment.

The power of authentic assessment lies in the student response. Analysis, problem solving, comparison, collaboration, and communication must come together in these assessments to prove adequate performance.

Students must be able to demonstrate that they can develop innovative approaches to solve both the analytical problems of the observed system and the social problems within their lab group. They must then be able to compare the results with their expectations and communicate their ideas to a general or specific audience. The purpose of the rubric is to allow students to know the outcomes of the assessment and to set goals toward the completion of the task. ✧

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REFERENCES

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FIGURE 1.

Energy transformation assessment.

Task: Write a narrative that describes the energy transformations that take place to run a television set. Mechanical, electrical, heat, radiant, and chemical energy must be presented and the transformations from one type to another must be explained. Begin your essay by explaining how radiant energy left the Sun millions of years ago. Continue with each of the transformations until energy leaves the television.

Rubric:

Topics	Scores			
	4	3	2	1
Communication: Understood by a variety of audiences.	Terms are well defined. Examples relate to common items. Complex concepts are simplified yet accurate.	Terms are defined. Examples are given. Complex concepts are adequately explained.	Terms are vague. Examples are incomplete. Complex concepts are not adequately addressed.	Terms are not defined and examples are not given. Complex concepts are not addressed.
Quality Producer: A product that reflects craftsmanship.	High level of logical reasoning. Clear and concise. Free of grammatical errors. Selected items are appropriate for the purpose and audience.	Some logical reasoning. Clear with few grammatical errors. Selected items are appropriate for the purpose and audience.	Some illogical reasoning. Many grammatical errors. Some items selected are inappropriate for the purpose or the audience.	Many illogical or incomplete conclusions. Many grammatical errors. Items selected are inappropriate for the purpose or audience.

FIGURE 2.

Phase change assessment.

Task: This is a three-day activity in which students observe and perform a distillation to demonstrate phase change, explain energy transformation, and identify key components in the system. On day one, a group of students writes a description of the distillation equipment that is placed in a location that the other class members cannot see. The rest of the class assembles the equipment laying on the lab tables according to this description. On day two, the lab groups use the setup to experiment with the phase change of water from liquid to gas and back to liquid. Each group writes their own statement of the problem, hypothesis, procedure, data table, and conclusion. On day three, each student describes individual components of the setup and explains how each part is used to cause water to change phase.

Rubric:

Topics	Scores			
	4	**3**	**2**	**1**
Collaborative Worker: Student can take charge of his/her own behavior in a group.	Student stays on task; offers useful ideas and can defend them; can take on various roles; participates without prompting.	Student stays on task; offers useful ideas and can defend them; can take on various roles; rarely requires prompting to participate.	Student does not attend to the lab. Student accepts group view or considers only his/her own ideas worthwhile. Student needs regular prompting to stay on task.	Student does not respond to the group. Student is not involved or may try to undermine the efforts of the group.
Scientific Literacy: Student uses processes and skills of science to conduct investigations.	Student identifies the question, forms a possible solution, writes out steps to test the possible solution, designs a data chart, collects data, and concludes about the validity of the possible solution.	Student identifies the question and forms a possible solution. Procedure and data chart are complete but lack clarity and/or creativity. Student concludes about the validity of the possible solution.	Student identifies the question but does not form a complete solution. Procedure and data chart are incomplete and the conclusion does not speak to the possible solution.	Student does not identify the question. No possible solution is given. Procedure and data chart are incomplete or missing. The conclusion is incomplete or missing.
Systems Analysis: Student describes how a system operates internally and how it interacts with the outside world.	Student identifies how parts of the system interact and provides personal insight into the interacting of the parts. Student relates how the system interacts with the outside world.	Student identifies how parts of the system interact and relates how the system interacts with the outside world.	Student does not identify some parts of the system. Student does not understand how the parts interact and does not relate how the system interacts with the outside world.	Student incorrectly identifies the parts and cannot describe how they interact either within or outside the system.

Distillation setup:

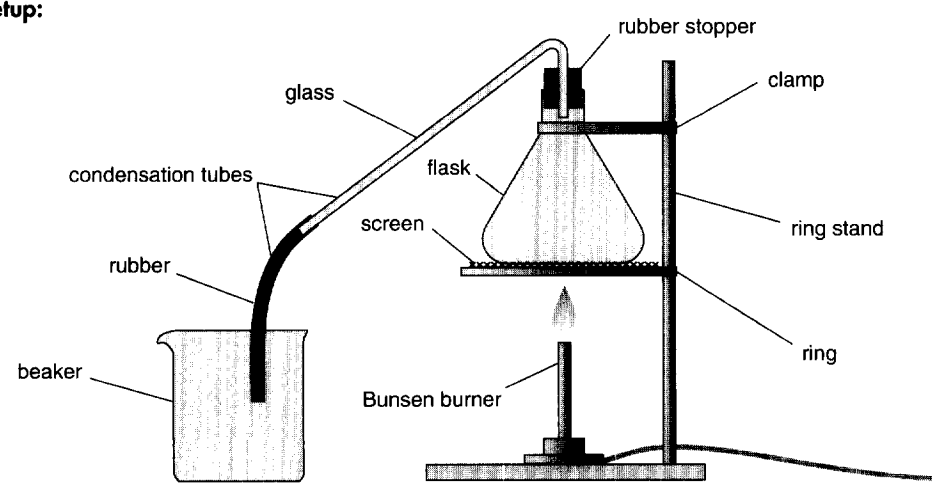

FIGURE 3.

Tornado story assessment.

Task: Write a story about a molecule of water that gets pulled up into a thunderstorm, becomes a hail stone, swirls through a tornado, and lands on the ground below. Be creative in your descriptions; however, make sure that you use the model of phase change, relate it to how energy moves through the atmosphere, and concentrate on how energy moves through a thunderstorm. Do not lose sight of the science in an effort to be creative.

Rubric:

Topics	Scores			
	4	3	2	1
Comparisons: Student is able to draw conclusions about the comparisons.	Student provides an accurate summary of all the information from each topic being compared. Student is able to evaluate the artistry to make sure that it does not oppose verified information.	Student provides an accurate summary of all the information from each topic being compared. Student allows artistic license to interfere with factual information.	Student leaves out pertinent information from topics being compared. Student's story does not accurately explain the scientific phenomena.	Student does not compare the topics and does not explain the scientific phenomena.
Arts and Humanities: Student creates an artistic literary product.	Student creates characters, plot, climax, and resolution. The story is clear without grammatical errors. The story is illustrated accurately, identifying the parts of the system.	Student writes a clear, grammatically correct story that speaks of at least one character.	The clarity of the story is compromised by problems with grammar. No characters are mentioned in the story.	The story has many grammatical errors and does not develop any character.