Mastery Grading System for Chemistry

Abstract

"Without continual growth and progress, such words as improvement, achievement, and success have no meaning."
-- Benjamin Franklin

The mastery grading system for chemistry is based heavily on a technique known as *standards-referenced* grading. The standards-referenced grading system scores students based on their ongoing improvement in various general and content skills, not as an average of their performance throughout the grading term. Essentially, it rewards students for diligence in working to master each skill in the course, and does not penalize them for lacking skills in any particular indicator when they first begin to learn new material. Instead, as they practice and participate in the course's inquiry activities, their skills improve and, commensurately, so do their scores improve. In effect, early, less successful attempts to demonstrate mastery have no impact on a student's final grade.

In this system, students do not receive a composite score or grade for each individual assignment that they complete as they might in a traditional course. Instead, students are scored on a 1 to 10 scale[1] for area of content and skills known as "mastery indicators." Each mastery indicator encompasses a specific chemistry topic or non-content "general skill," which in turn contains a number of concepts, ideas, and skills that students will be able to do flawlessly (or nearly so) by the end of the course. Each indicator is scored based on a simple rubric which essentially describes a student's relative mastery for that area.

A substantial benefit of the mastery grading system is that it offers the instructor only a small amount of discretion in the assigning of a mastery score (since the mastery of a concept is cut and dry, especially in qualitative analyses, since the student's projected skills are based on the New Jersey Core Curriculum Content Standards for science). As in any inquiry-based classroom, students will also participate in metacognition and self-reflection with some frequency, and their explanation of their thinking will aid them in boosting any given score to a higher level of mastery.

Most importantly, because each and every assessment explicitly defines the mastery indicators necessary for that assessment, along with an "expected mastery" to solve the problem thoroughly, students get instant and specific feedback on their strengths and weaknesses, and can focus their efforts on specific skills and concepts. Traditional assessments, which are typically scored out of an arbitrary number of points, do not by their nature provide students with specific feedback on their strengths and weaknesses, and therefore the instructor is as unaware of each of the students' needs as are the students themselves. Mastery grading offers just this type of feedback, and makes it easy and systematic for students to determine their exact current performance and future improvement needs.

How Student Skills are Assessed

The mastery grading system serves to reinforce individual skills as a part of the whole, even when they are presented as component parts of a problem or system to be solved. Mastery grading allows students to determine their precise areas of strength and weakness and focus on honing and refining those skills.

Whenever a problem is presented for grading, a grid of "Mastery Indicators" required for completion of a problem will be provided with the assessment. Each of these areas can be scored referred to as a "Mastery Score") on a

[1] This scale is arbitrary, selected primarily because it lends itself to simple mental math. Some mastery indicators could easily be adjusted to weight a particular group of topics or reflect a lesser or greater importance of an area.

scale of 1 through 10, with a 1 indicating Below Basic mastery, and a 10 indicating Superior mastery. These individual scores are not combined to give an overall "grade;" rather, the individual skill mastery areas have an impact on the student's overall grade for the term.

Competence in all of the mastery indicators for the term is reflected in a running tally of the student's grade for the term. Of course, the end of each marking period requires computation of final grade. The student's overall mastery of chemistry content is reflected in the form of a traditional percentile grade on the report card – a simple average of all of the mastery indicators being assessed for that term.

When a student achieves a degree of mastery in a particular area (on the 1 to 10 scale), the instructor uses the mastery value to compute the grade for the term. Since chemistry is a cumulative subject, any mastery indicators that are necessary for the following term are transferred to that term *beginning at the level of mastery achieved in the previous term.* For example, if a student achieves mastery score of 8 in Dimensional Analysis in Marking Period 1, that student would begin Marking Period 2 with a mastery score of 8 in Dimensional Analysis. From this point, the student can continue to improve that score (or, strictly speaking, it could dip back below 8).[2]

Adaptation to ProgressBook and East Culture

In an effort to integrate Mastery Grading into the Chemistry 1A course at Cherry Hill East, certain considerations must be made of the method used to rank students and the limitations of the grade-tracking software, ProgressBook.

In this Chemistry course, students will be assessed and scored using the Mastery Indicators, but several instances of the same indicator may appear throughout the course of the term. These may be adjusted in their scale (out of 5, or 6, or 8, for example, rather than 10) to reflect the relative difficulty and, ultimately, mastery of each specific assessment. As with the normal Mastery Grading System, students will be have multiple opportunities to improve their previous scores, with lower scores having little or no impact on later, improved scores.

I also reserve the right to offer "interim assessments;" that is, composite assessments scored outside of the Mastery Indicators. These assessments will typically be formative, and will supplement the mastery indicators, especially for units with many complex and challenging concepts.

Further Information

The document entitled "Mastery Grading System for Chemistry – Rules & Metrics," available separately (see below), contains extensive details on for Mastery Grading and for the standards-referenced system on which it is based. This document includes a detailed list of mastery indicators, the topical breakdown for each indicator, educational research and literature references, an assessment example, and detailed rubrics for all mastery indicators.

To download and review the complete Mastery Grading document as well as other course materials, please visit the following course website and select "Chemistry 1A" from the options:

http://courses.digitaldapp.org

[2] This practice is somewhat controversial, but the spirit of standards-referenced grading relies on the core idea that students are assessed on their most recent (and, hopefully, most successful work). This particular aspect of mastery grading remains open to the possibility of modification, depending on the success of students under the mastery grading system for the first term.