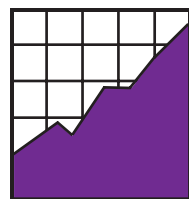


**Alternate Assessments Measured Against
Grade-level Achievement Standards:
The Massachusetts “Competency
Portfolio”**



NATIONAL
CENTER ON
EDUCATIONAL
OUTCOMES

In collaboration with:

Council of Chief State School Officers (CCSSO)

National Association of State Directors of Special Education (NASDSE)

Synthesis Report 59

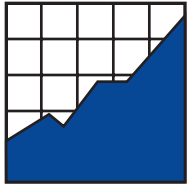
Alternate Assessments Measured Against Grade-level Achievement Standards: The Massachusetts “Competency Portfolio”

Dan Wiener
Massachusetts Department of Education

January 2006

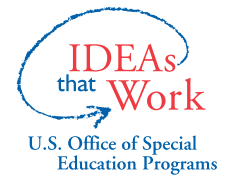
All rights reserved. Any or all portions of this document may be reproduced and distributed without prior permission, provided the source is cited as:

Wiener, D. (2006). *Alternate assessments measured against grade-level achievement standards: The Massachusetts “competency portfolio”* (Synthesis Report 59). Minneapolis, MN: University of Minnesota, National Center on Educational Outcomes.



**N A T I O N A L
C E N T E R O N
E D U C A T I O N A L
O U T C O M E S**

The Center is supported through a Cooperative Agreement (#H326G000001) with the Research to Practice Division, Office of Special Education Programs, U.S. Department of Education. The Center is affiliated with the Institute on Community Integration at the College of Education and Human Development, University of Minnesota. Opinions expressed herein do not necessarily reflect those of the U.S. Department of Education or Offices within it.



NCEO Core Staff

Deb A. Albus	Ross E. Moen
Manuel Barrera	Michael L. Moore
Christopher J. Johnstone	Rachel F. Quenemoen
Jane L. Krentz	Dorene L. Scott
Kristi K. Liu	Martha L. Thurlow, Director

National Center on Educational Outcomes
University of Minnesota • 350 Elliott Hall
75 East River Road • Minneapolis, MN 55455
Phone 612/626-1530 • Fax 612/624-0879
<http://www.nceo.info>

The University of Minnesota is committed to the policy that all persons shall have equal access to its programs, facilities, and employment without regard to race, color, creed, religion, national origin, sex, age, marital status, disability, public assistance status, veteran status, or sexual orientation.

This document is available in alternative formats upon request.

Background

Alternate assessment originated in Kentucky in 1992 (National Alternate Assessment Center, 2005), and was mandated nationally by the Individuals with Disabilities Education Act of 1997. Alternate assessment acts as a mechanism for inclusion in large-scale educational assessments for those students with disabilities who cannot participate in regular state and district assessments, even with accommodations and modifications. The No Child Left Behind Act of 2001 (NCLB), the Individuals with Disabilities Educational Improvement Act of 2004 (IDEA), and subsequent regulations reinforce the requirement that states develop alternate assessments for students who need them in order to be appropriately included in assessment and accountability systems. The law and regulations also clarify that alternate assessments on grade-level achievement standards can be designed to assess the achievement of students with disabilities other than the most significant cognitive disabilities, who, often, cannot show what they know on the general assessment, even with accommodations. NCLB requires that alternate assessments for these students must be comparable to the general assessment both in content standard coverage and achievement standards. Regardless of whether alternate or grade-level achievement standards are set, all assessment options are to be aligned to grade-level content standards.

In addition, several states have implemented graduation tests as a condition of receiving a high school diploma. There is much that states must still do to expand opportunities for students with disabilities to demonstrate what they know and can do through ways other than those typically used in large-scale assessments. One option that states have considered is to provide students with alternative methods for showing proficiency (Krentz, Thurlow, Shyyan, & Scott, 2005).

To ensure full participation in assessment and accountability systems, whether for NCLB accountability purposes or for graduation or promotion, students with disabilities unable to take statewide paper-and-pencil tests may require alternate assessments. Some of these students have significant cognitive disabilities and are working substantially below the performance expectations of other students in their grade. Sometimes, though, the nature of the student's primary disability is not cognitive, though still complex and significant enough to require an alternate assessment, for example a student with cerebral palsy or an intensive emotional disability. This latter group of students may be working at or close to a performance level comparable with typical peers, but cannot take the on-demand paper-and-pencil test, even with accommodations, due to their disability. The alternate assessments taken by these students must be able to measure their performance against grade-level achievement standards, rather than the alternate achievement standards normally associated with students with the most significant cognitive disabilities.

The focus of this discussion will be on those students who require alternate assessments based on grade-level achievement standards, and how such alternate assessments can reliably measure their achievement in a manner that is equivalent to students who are taking the regular state as-

assessment for that grade. The Massachusetts Department of Education (the “Department”) has developed an alternate assessment based on grade-level achievement standards consisting of a structured portfolio of student work collected over a period of time, and reviewed by experts in the content area. This option can be used for two purposes: to ensure appropriate participation for all students in system accountability for NCLB purposes and to ensure appropriate assessments for all students for the purpose of competency determination for a diploma. In this paper, the “competency portfolio” will be discussed, including how the model was developed and validated, and how a small but growing number of students are using this format as an alternative pathway to participate in the Massachusetts Comprehensive Assessment System (MCAS) and, ultimately, satisfy the state’s graduation requirement.

Why Students Take Alternate Assessments

First, it is important to clarify why students take alternate assessments of any type. There are many reasons why a student with a disability might need an alternate assessment. IEP teams must make careful decisions about how each student will participate in statewide assessments, based on their knowledge of and familiarity with the student and his or her prior instructional and assessment experiences. State assessment policies must also require teams to revisit previous assessment decisions on an annual basis and make adjustments to their earlier determinations, as needed, rather than maintaining a student on an alternate assessment participation track for the duration of his or her education. Students should also be permitted to take standard tests with accommodations when this is appropriate and possible in certain subjects, while taking alternate assessments in another.

Students with the most significant cognitive disabilities comprise the majority of students taking alternate assessments. These students are required to work on grade-level content standards, but will likely be focusing on these standards at levels of complexity substantially below that of their non-disabled peers. As a result, the standard test at their grade-level would not allow the student access to the assessment in order to participate, nor would it yield meaningful results or information needed to improve subsequent instruction for the student.

Students with other significant (non-cognitive) disabilities may also require alternate assessments, but for different reasons, especially when the effects of their disabilities cannot be overcome in order to participate in standard tests. The number of such students is relatively low in Massachusetts, about 5-6% of the number of students taking alternate assessments based on alternate achievement standards. Some of these students might be able to take the general assessment if appropriate accommodations were identified, available, and provided, though not always.

At whatever rate and frequency the disabilities of these students hinder their participation in general assessments, they are entitled to take assessments that allow them to demonstrate

knowledge and skills at the highest and most challenging levels of complexity. This means the alternate assessment must measure the same grade-level achievement as their peers, though using a different assessment format and context.

These students present a dilemma to states charged by law with assessing all students using valid and reliable methods. They exist in small, but significant numbers, and without their meaningful participation in appropriate assessments, the state's assessment system cannot truly be said to be fully inclusive. Still, few states have developed alternate assessments based on grade-level achievement standards. This places these students in a difficult and vulnerable position. Their IEP teams are forced to choose from among several unsuitable assessment options, and it raises the possibility of legal challenges in states where graduation testing requirements may restrict their access to a diploma.

Why Students Take Alternate Assessments based on Grade-level Achievement Standards?

It is important to review characteristics of students who require alternate assessments based on *grade-level* achievement standards in order to understand why it is necessary to develop alternate assessments for them. The following profiles are meant to expand an awareness of the characteristics of these students, though it is not meant to be an exhaustive list. The intent is to illustrate the attributes that should impel IEP teams to consider alternate assessments based on grade-level achievement standards for these students, due to the complexity, severity, and exceptional nature of their disabilities. Examples of these students might include:

- Students unable to “maintain sufficient concentration” to participate in standard testing, even with test accommodations, as a consequence of a severe emotional disability, traumatic brain injury, autism or Asperger’s Syndrome, or other disability or combination of disabilities.
- Students for whom the “demands of a prolonged test administration” would present a significant challenge, as a consequence of a health-related, multiple physical, or other disability.
- Students who require “more time than is reasonable or available” for testing, even with the allowance of extended time, as a consequence of cerebral palsy, deaf-blindness, or a significant motor, communication, or other disability.
- Students for whom the “format of the standard test is inappropriate,” and the necessary accommodations are unavailable or would “give away” or hint at the answers.
- Students who do not have significant cognitive disabilities, but whose disabilities result in other “unique and significant challenges” to taking the standard test.

From the qualities listed above, it should be clear to policy-makers and members of IEP teams that such students cannot participate in standard paper and pencil on-demand tests, even with accommodations, without seriously compromising the validity of those results. Alternate assessments based on alternate achievement standards are likewise inappropriate.

When its statewide assessment advisory committee recommended to the Massachusetts Department of Education in 1999 that students with “unique and significant challenges” also be permitted to take alternate assessments, and that the alternate assessment ultimately allow them to meet the state’s graduation requirement, the idea of a “competency portfolio” was born.

Challenges in Determining an “Equivalent” Performance on Alternate Assessments

IEP teams in Massachusetts have been trained to recognize the characteristics of students who should be considered for alternate assessments, including both students with the most significant cognitive disabilities and those with “unique and significant” (primarily non-cognitive) disabilities. Guidelines for IEP team decision-making on alternate assessment participation have been circulated since 1999.

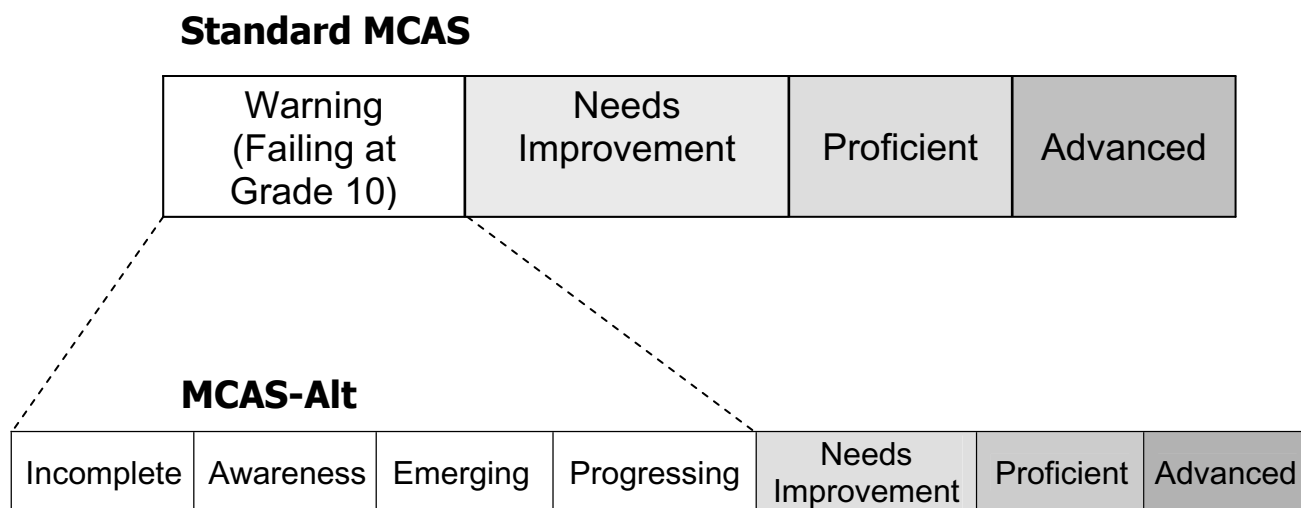
In broadening the participation criteria to include both groups of students, the alternate assessment itself had to become sufficiently flexible to accommodate the creation and scoring of portfolios for students working at levels of complexity ranging from substantially below to comparable with, and even above, the level of their non-disabled grade-level peers.

As a result, the reporting system required a seamless progression of achievement levels reflecting student performance based on alternate as well as grade-level achievement standards. Figure 1 shows how the Massachusetts Comprehensive Assessment System (MCAS) integrated its performance levels for statewide reporting on alternate assessments to allow comparisons of all students taking alternate assessments, whether measured against alternate or grade-level achievement standards.

Design and Implementation of Alternate Assessments Based on Grade-level Achievement Standards

Portfolios do not assess student learning precisely in the same way as standard assessments, due in part to the large number of learning standards and skills required for documentation. However, portfolios have several distinct advantages over on-demand tests, including demonstration of growth and learning over a period of time, development of an individualized learning sequence and pace of instruction (Seidel et al., 1997), and relieving students of the intense physical and

Figure 1. Performance Levels on MCAS and MCAS-Alt



emotional demands of test-taking. New methods and criteria for examining student work will need to be established for this alternate assessment, and information will need to be included with student work telling how the instructional tasks were conducted, and describing the frequency and types of assistance, if any, given to the student.

Further, the design of these methods and criteria must be based on a foundation of rigorous and challenging content. Thus, the direct participation and involvement of content experts is perhaps the most critical element in the design of an alternate assessment based on grade-level achievement standards, since individuals most familiar with the standards in the content area are those who are most qualified to identify the key skills and content to be assessed, and to assist the state in determining the benchmarks needed to reach each level of achievement.

The role of content experts in developing the Massachusetts “competency portfolio” was identified in early discussions. It became obvious that not every learning standard assessed on the general assessment could be documented in a portfolio, due to the unrealistic amount of time and effort such a range of learning standards would entail. Particularly, in a state like Massachusetts with a state requirement to demonstrate competency in English language arts (ELA) and mathematics, practitioners had to agree on the primacy of certain learning standards, so students could demonstrate proficiency in essential areas deemed most significant by secondary-level content experts. These experts assisted the Department in identifying the most critical standards for documentation, and continue to advise the Department on fine-tuning this process.

States must be thorough, thoughtful, and collaborative in their approach to developing alternate assessments based on grade-level achievement standards because of the inherent differences in assessment formats, particularly when results are used to determine high stakes for students,

such as promotion or graduation. Massachusetts students, for example, must eventually pass the grade 10 MCAS assessments in English language arts and mathematics as part of the state's requirement to earn a diploma. The cut score for passing these standard assessments is a score of 220 on the tests, the lowest scaled score within the *needs improvement* performance level. Performance levels on MCAS tests are scaled as follows: *warning/failing* (200-218); *needs improvement* (220-238); *proficient* (240-258); *advanced* (260-280). Although performance at the *needs improvement* level in grade 10 is sufficient for students to meet the state's graduation requirement, a score of *proficient* is required to meet the federal definition of proficiency for No Child Left Behind.

While some students with disabilities in Massachusetts score at the *needs improvement* and *proficient* levels on their grade 10 assessments, those who do not are encouraged to work until the end of grade 12, or longer, to achieve a score of at least *needs improvement* and earn their diplomas. It is important for states to provide incentives to continue the intensive instruction of these students beyond grade 10, even though their scores do not count in the AYP calculations of their schools and districts, and to provide them with academic support programs and opportunities to take successive retests. It is equally important that IEP teams be permitted to designate these students for alternate assessments, when necessary, and that these students be permitted to meet all state requirements to graduate when they take these alternate assessments. Taking an alternate assessment should not automatically remove any student from the possibility of earning a diploma, since in many cases it is not known precisely how much these students are capable of learning.

In each of the classes of 2003 and 2004 in Massachusetts, 80-82% of students with disabilities met the threshold for graduation by the end of grade 12. As of this writing, about seventy-five Massachusetts students have successfully earned their diplomas by taking alternate assessments based on grade-level achievement standards. The process of reviewing the portfolios is described more fully in the next section.

The "Competency Portfolio" Review Process

The evidence in the MCAS Alternate Assessment (MCAS-Alt) portfolio determines whether a student's performance will be measured based on grade-level achievement standards or alternate achievement standards. During the portfolio review process, scorers (primarily special educators) determine whether a portfolio demonstrates student performance either at, or close to, grade-level complexity and expectations. Through this winnowing process, portfolios identified as "at or close to grade-level expectations" are set aside and subsequently reviewed by content experts who verify that the portfolio should indeed be reviewed based on grade-level achievement standards. The expert panels then review for depth, breadth, and overall comparability

with a student who has passed the corresponding MCAS test, based on their familiarity with the learning standards and with the performance expectations for students who have passed the grade 10 tests. Specific requirements to meet the Competency Determination standard are described in the Appendix.

For students in grades 3–8, where the stakes are arguably lower (i.e., no retention or promotion, although sanctions may result for schools and districts based on AYP determinations), the alternate assessment based on grade-level expectations is nevertheless held to high standards for breadth, depth, and quantity. Documentation is required in at least three learning standards in each of three “strands” (or subdomains) in the content area being assessed. When work samples are determined to be at a level of complexity comparable with a student in that grade, as determined by a panel of content experts in grades 3–8, and the work is both accurate and independently produced by the student, then the student earns a score of *needs improvement*, *proficient*, or *advanced*, based on an equivalent performance of a student scoring at these performance levels on the test.

At grade 10, the requirements to meet the graduation standard were set considerably higher. Content experts advised the Department that evidence of only three learning standards per strand would be inadequate to meet the Competency Determination standard. Portfolio submission requirements for grade 10 students were developed with specific products in mind, based on learning standards selected for documentation by curriculum and assessment experts in English and math.

With support from technical advisors and state contractors, the Department developed separate requirements for the English language arts and mathematics competency portfolios. Since the ELA general assessment is primarily an assessment of language, reading comprehension, and writing skills, test developers and assessment experts conceived a portfolio based on writing samples that responded to a piece of grade 10 literature in which the student addressed themes in the work, rather than simplistic plot summaries. Students were required to show successive drafts and revisions, with self-generated edits guided by teachers’ comments and feedback. Specific ELA competency portfolio requirements are shown in the Appendix.

Math test developers and *curriculum framework* writers, on the other hand, took a more prescriptive approach to the math competency portfolio. They identified between two and four learning standards in each of five Math “strands” for documentation in the portfolio through a collection of work samples focused on each required standard. The selected learning standards typically were either the most difficult, most comprehensive, or those that subsumed other standards within them. In some strands (geometry, for example), teachers and students could choose any three standards on which to base their work samples. In other strands, specific standards were pre-selected for documentation. Students are required to solve problems accurately and inde-

pendently, and to show all steps in solving the problems, plus show evidence of applying the standard in novel situations, rather than simply recalling or repeating information.

A Level of Complexity (“5”) was added to the MCAS-Alt scoring rubric to reflect a student who had submitted work of this depth and breadth. A score of 5 is necessary for a student to “pass” the assessment in order to earn a Competency Determination. Figure 2 shows the Level of Complexity scoring area in the MCAS-Alt scoring rubric, reflecting a range of complexity and alignment of portfolio evidence with grade-level academic learning standards.

Figure 2. MCAS-Alt Scoring Rubric: Level of Complexity

1	2	3	4	5
Portfolio reflects little or no basis on <i>Curriculum Frameworks</i> learning standards in this strand.	Student primarily addresses social, motor, and communication “access skills” during instruction based on <i>Curriculum Frameworks</i> learning standards in this strand.	Student addresses “entry points,” or modified (i.e. less difficult) <i>Curriculum Frameworks</i> learning standards below grade-level expectations in this strand.	Student addresses a narrow sample of <i>Curriculum Frameworks</i> learning standards (1 or 2) at grade-level expectations in this strand.	Student addresses a broad range of <i>Curriculum Frameworks</i> learning standards (3 or more) at grade-level expectations in this strand.

Opportunities to Resubmit Portfolios for Graduation Beyond Grade 10

Students are given multiple opportunities beyond grade 10 to pass these assessments and earn a diploma by resubmitting their competency portfolios with additional work samples in grades 11 and 12, and even beyond grade 12. A detailed summary of the portfolio review is returned to each school that allows educators to focus instruction in precisely the areas in which it is needed, and resubmit the enhanced portfolio, until such time as the student demonstrates competency on the grade-level content. The decision to resubmit a competency portfolio beyond grade 10 is at the discretion of the student’s IEP/504 team, based on whether the student, in their judgment, is approaching a grade 10 level of achievement.

It is clear that portfolio submissions will need to occur over the course of several school years for some students beginning in grade 10. A collaborative approach among general and special educators will be needed to do this effectively. There is now ample evidence to indicate that this portfolio process has fostered both that collaboration and thoughtful, long-range planning among general and special educators for these students.

Conclusion

States will need to document the validity of assessments used to assess and report the academic performance of all students, based on the requirements in the No Child Left Behind law. A small but significant number of these students will not be able to take the standard test because of the nature and complexity of their disabilities, but are also ill-suited to take alternate assessments based on alternate achievement standards, since their knowledge and skills are at comparable levels with their non-disabled peers. The assessment results of these students based on either of these existing assessment formats will be invalid for the purpose of reporting and accountability. A more flexible and responsive approach is needed to assess these students. As assessments are used to make decisions that have a direct impact on students, states will run the risk of being held accountable by the public to show that results were obtained using fair and precise assessments.

States in increasing numbers are also looking to verify that students graduating from high school can demonstrate the core competencies acknowledged as important in becoming productive citizens and lifelong learners. These states must balance resources and capacity, external pressures, and political concerns in considering whether and how to implement graduation requirements for students. Approaches that rely on the use of only one assessment method by which students can meet these high-stakes requirements will inevitably be challenged by the families of students who claim to have these skills and competencies, but cannot demonstrate them effectively on standard tests. States must therefore decide whether to develop alternative pathways to a diploma for the comparatively small number of students who need them. In so doing, they will ensure that their assessment system remains responsive to the needs of a full range of students, so all will have the opportunity to demonstrate their skills effectively. This report presented one such model of an alternative pathway used by a state to meet diploma requirements.

References

National Alternate Assessment Center. (2005). *The assessment triangle and students with significant cognitive disabilities: Models of student cognition*. Lexington, KY: Interdisciplinary Human Development Institute, University of Kentucky.

Krentz, J., Thurlow, M., Shyyan, V., & Scott, D. (2005). *Alternative routes to the standard diploma* (Synthesis Report 54). Minneapolis, MN: University of Minnesota, National Center on Educational Outcomes.

Massachusetts Department of Education. (1999). *Participation guidelines for MCAS alternate assessment*. Malden, MA: Author.

Massachusetts Department of Education. (2004). *2005 educator's manual for MCAS alternate assessment*. Malden, MA: Author

Massachusetts Department of Education. (2000). *Massachusetts mathematics curriculum framework*. Malden, MA: Author.

Massachusetts Department of Education. (2001) *Massachusetts English language arts curriculum framework*. Malden, MA: Author.

Seidel, S., Walters, J., Kirby, E., Olf, N., Powell, K., Scripp, L., & Veneema, S. (1997). *Portfolio practices: Thinking through the assessment of children's work*. Cambridge, MA: President and Fellows of Harvard College.

Appendix A

MCAS-Alt Grade 10 “Competency Portfolio” Requirements in ELA and Math

MCAS-Alt Grade 10 “Competency Portfolio” Requirements in ELA and Math

Following are the specific MCAS-Alt portfolio requirements for a student in grade 10 (or beyond) to earn a *Competency Determination*:

The student’s portfolio must:

1. demonstrate knowledge and skills *at grade-level expectations for a student in grade 10*;
2. reflect a performance level of *needs improvement* or higher in both ELA and Mathematics; and
3. document that the student has independently addressed *all* required learning standards and strands in the subject being assessed, as described below.

ENGLISH LANGUAGE ARTS (ELA) – portfolios must reflect the learning standards in the Massachusetts *English Language Arts Curriculum Framework* (June 2001) and must include:

- **FIVE written work samples** as described below;
- **Multiple drafts** of each work sample that indicate a progression of the student’s thinking in each successive draft. Each must:
 - be clearly identified on the first page with a title, the student’s name, and the date on which it was produced;
 - be written in the words of the student, with independent edits and meaningful revisions incorporated into subsequent drafts (i.e., not rewritten by the teacher for the student);
 - include a clear description of the type(s) and frequency of assistance provided to the student by the teacher; and
 - not include worksheets, short-answer tests, quizzes, or plot summaries.

An English Language Arts portfolio may include evidence produced and accumulated over **more than one school year**, beginning as early as grade 9. Evidence may be added to a previously-submitted portfolio, or replaced with higher-quality work, and the entire portfolio resubmitted each year beyond grade 10 until the student demonstrates a level of performance equivalent to that of a student who scored *needs improvement* or higher on the grade 10 ELA MCAS test.

English Language Arts Strand:	A grade 10 portfolio <i>must</i> include the following components, at minimum, in order to be considered for the <i>Competency Determination</i> .
Language	Evidence provided either in separate work samples or incorporated into the five required writing samples, that the student understands and is independently able to analyze and appropriately apply the following: <ul style="list-style-type: none"> ♦ Vocabulary: words used correctly; literal/figurative meaning ♦ Grammar and usage: sentence structure and language conventions ♦ Mechanics: punctuation and spelling

Reading and Literature	<p>Three essays or compositions, including all drafts, and based on grade 10 literature in which the student analyzes, interprets, compares and contrasts, and/or discusses the meaning of the following:</p> <ol style="list-style-type: none"> 1. a work of literary non-fiction, 2. a work of fiction, and 3. a work of either poetry or drama.
Composition	<p>Two essays or compositions, including all drafts, that demonstrate original thinking and independent editing through several drafts, as follows:</p> <ol style="list-style-type: none"> 1. one essay or composition in which the student identifies and discusses a theme in literature appropriate to a student in grade 10 and/or connects such a literary theme to his or her life 2. one essay or composition, including all drafts, on a topic of the student's own choosing that is reflective, persuasive, or fictional

MATHEMATICS – Mathematics portfolios must reflect the learning standards in the most recent Massachusetts *Mathematics Curriculum Framework* (November 2000) and must include:

- a **table of contents** listing each piece of evidence (work sample) submitted, and the strand and learning standard(s) it purports to address,
- at least **four examples or problems** solved correctly by the student that demonstrate all aspects of each learning standard documented in the portfolio. Additional examples of each standard are strongly encouraged. Original evidence, rather than photocopies, is preferred,
- a *Grade 10 Work Description* attached to each work sample that documents a particular learning standard,
- a **score** (% accurate) given by the teacher for each work sample,
- work samples produced as independently as possible by the student; corrections made by the teacher may not be submitted as the student's own work,
- written evidence of the student's thinking and problem-solving, indicating the process used to solve each problem (i.e., “show all work”),
- a clear indication of the type(s) and frequency of assistance provided to the student by the teacher, either written directly on each piece or described on the *Grade 10 Work Description*

Students in grade 10 may not have had an opportunity to take all mathematics courses needed to satisfy the requirements listed below. Therefore, a Mathematics portfolio may include evidence produced over a period of **more than one school year**, beginning not earlier than grade 9. Evidence may be added to an existing portfolio and resubmitted annually beyond grade 10.

<p>Mathematics Strand:</p>	<p>A grade 10 portfolio <i>must</i> include evidence that addresses at least the following learning standards to be considered for the <i>Competency Determination</i>:</p>
<p>Number Sense and Operations</p>	<p><i>A total of at least two work samples, one documenting each of the two learning standards listed below:</i></p> <p>10.N.1—Identify and use the properties of operations on real numbers, including the associative, commutative, and distributive properties [do not simply define these properties; show how they are applied and demonstrate that students can identify each property; e.g., use the distributive property to multiply $7(23) = 7(20 + 3) = 7(20) + 7(3) = 140 + 21 = 161$]; the existence of the identity and inverse elements for addition and multiplication; the existence of n^{th} roots of positive real numbers for any positive integer n; and the inverse relationship between taking the n^{th} root of and the n^{th} power of a positive real number.</p> <p>10.N.2—Simplify numerical expressions, including those involving positive integer exponents or the absolute value [e.g., $3(2^4 - 1) = 45$, $4 3 - 5 + 6 = 14$]; apply such simplifications in the solution of problems.</p>
<p>Patterns, Relations, and Algebra</p>	<p><i>A total of at least four work samples, one documenting each of the four learning standards listed below:</i></p> <p>10.P.2—Demonstrate an understanding of the relationship between various representations of a line. Determine a line’s slope and x- and y-intercepts from its graph or from a linear equation that represents the line. Find a linear equation describing a line from a graph or a geometric description of the line (e.g., by using the “point-slope” or “slope y-intercept” formulas). Explain the significance of a positive, negative, zero, or undefined slope.</p> <p>10.P.4—Demonstrate facility in symbolic manipulation of polynomial and rational expressions by rearranging and collecting terms; factoring [e.g., $a^2 - b^2 = (a + b)(a - b)$; $x^2 + 10x + 21 = (x + 3)(x + 7)$; $5x^4 + 10x^3 - 5x^2 = 5x^2(x^2 + 2x - 1)$]; identifying and canceling common factors in rational expressions; and applying the properties of positive integer exponents. [This standard does <i>not</i> include simple addition, subtraction, and multiplication of polynomials, as covered in 10.P.3.]</p> <p>10.P.5—Find solutions to quadratic equations (with real roots) by factoring, completing the square, or using the quadratic formula. Demonstrate an understanding of the equivalence of the methods.</p> <p>10.P.7—Solve everyday problems that can be modeled using linear, reciprocal, quadratic, or exponential functions. Apply appropriate tabular, graphical, or symbolic methods to the solution. Include compound interest, and direct and inverse variation problems. Use technology when appropriate.</p>

<p>Geometry</p>	<p><i>A total of at least three work samples, one documenting each of any three learning standards listed below:</i></p> <p>10.G.1 —Identify figures using properties of sides, angles, and diagonals. Identify the figures’ type(s) of symmetry.</p> <p>10.G.2 —Draw congruent and similar figures using a compass, straightedge, protractor, and other tools such as computer software. Make conjectures about methods of construction. Justify the conjectures by logical arguments.</p> <p>10.G.3 —Recognize and solve problems involving angles formed by transversals of coplanar lines. Identify and determine the measure of central and inscribed angles and their associated minor and major arcs. Recognize and solve problems associated with radii, chords, and arcs within or on the same circle.</p> <p>10.G.4 —Apply congruence and similarity correspondences (e.g., $\triangle ABC \cong \triangle XYZ$) and properties of the figures to find missing parts of geometric figures, and provide logical justification.</p> <p>10.G.5 —Solve simple triangle problems using the triangle angle sum property and Pythagorean theorem.</p> <p>10.G.6 —Use the properties of special triangles (e.g., isosceles, equilateral, $30^\circ-60^\circ-90^\circ$; $45^\circ-45^\circ-90^\circ$) to solve problems.</p> <p>10.G.7 —Using rectangular coordinates, calculate midpoints of segments, slopes of lines and segments, and distances between two points, and apply the results to the solutions of problems.</p> <p>10.G.8 —Find linear equations that represent lines either perpendicular or parallel to a given line and through a point, e.g., by using the “point-slope” form of the equation.</p> <p>10.G.9 —Draw the results, and interpret transformations on figures in the coordinate plane, e.g., translations, reflections, rotations, scale factors, and the results of successive transformations. Apply transformations to the solutions of problems.</p> <p>10.G.10—Demonstrate the ability to visualize solid objects and recognize projections and cross sections.</p> <p>10.G.11—Use vertex-edge graphs to model and solve problems (i.e., network).</p>
------------------------	--

Measurement	<p><i>A total of at least three work samples, one documenting each of the three learning standards listed below:</i></p> <p>10.M.1—Calculate perimeter, circumference, and area of common geometric figures such as parallelograms, trapezoids, circles, and triangles.</p> <p>10.M.2—Given the formula, find the lateral area, surface area, and volume of prisms, pyramids, spheres, cylinders, and cones (e.g., find the volume of a sphere with a specified surface area).</p> <p>10.M.3—Relate changes in the measurement of one attribute of an object to changes in other attributes, e.g., how changing radius or height of a cylinder affects its surface area or volume</p>
Data Analysis, Statistics, and Probability	<p><i>A total of at least two work samples, one documenting each of the two learning standards listed below:</i></p> <p>10.D.1—Select, create, and interpret an appropriate graphical representation (e.g., scatterplot, table, stem-and-leaf plot, box-and-whisker plot, circle graph, line graph, line plot) for a set of data and use appropriate statistics (e.g., mean, median, range, mode) to communicate information about the data. Use these notions to compare different sets of data.</p> <p>10.D.2—Approximate a line of best fit (i.e., draw a trend line) given a set of data (e.g., scatterplot). Use technology when appropriate.</p>