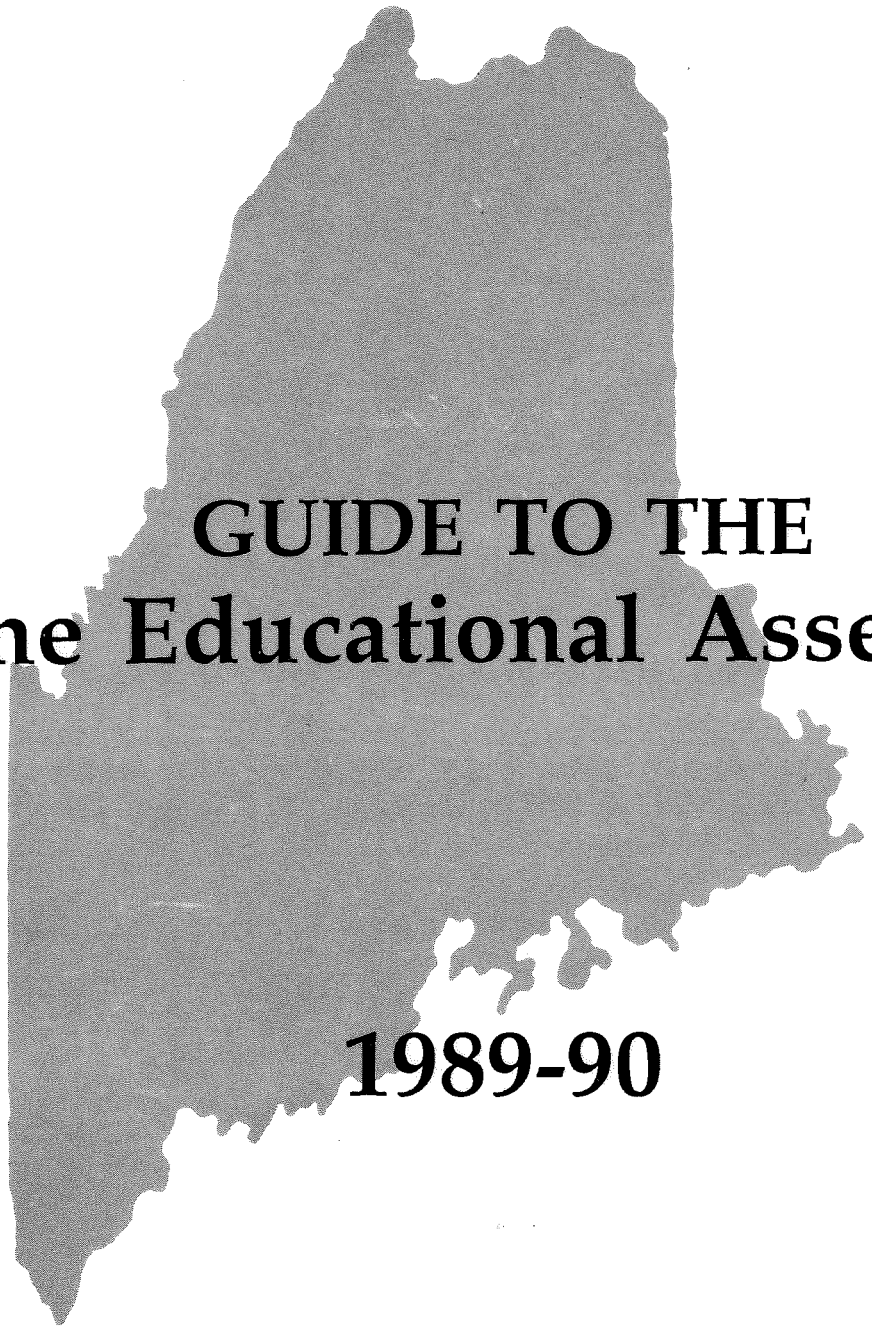

GUIDE TO THE
Maine Educational Assessment

1989-90

Department of Educational and Cultural Services
Division of Educational Assessment

CONTENTS

FOREWORD

This past year, as in the previous years, the Maine Educational Assessment received a great deal of cooperation from Maine educators. This kind of support has been critical to the operation of the program since its beginning five years ago. In 1988-89, we initiated several evaluation activities and, in the process, turned our attention to MEA utilization and impact. A survey involving all Maine schools addressed the extent to which the MEA test content is covered in local curricula and, in so doing, served a validation function. My staff and I have spent considerably more time visiting schools and school district offices in order to explain the testing program, help interpret local results, discuss implications for instruction in the various subject areas, and assist in making presentations to school boards. Data collected through the MEA have been used by many divisions in the Department of Educational and Cultural Services. Various professional groups have met to discuss ways the MEA can be used in research efforts investigating many of the problems and issues of concern in our schools. A brochure, *Using Results of the MEA and Other Tests in Maine*, was distributed widely throughout Maine schools. A special focus of our teacher and principal questionnaires was on the use and impact of the various reports and report sections produced by the MEA. In addition to addressing MEA utilization, a special superintendent's questionnaire provided a forum for superintendents to express their views regarding many aspects of the MEA and to make recommendations, both specific and general in nature.

While it may be impossible to please all of the people all of the time, we have been very pleased with what we are seeing about how the MEA is being utilized and received in many places. There are still persons who could benefit from knowing more about the program, and there are still places that could make better use of MEA data. Furthermore, there are still ways the MEA can be improved and, at the same time, serve the needs it has served effectively so far. I hope that in 1989-90 superintendents, principals, curriculum specialists, teachers, professional associations, and other groups of Maine educators make more and more use of the MEA data and the services of my staff. I will be relying on the continued assistance of those same groups in operating and improving the program.

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QUESTIONS AND ANSWERS

The Maine Educational Assessment is a program growing out of the Educational Reform Act of 1984. That legislation called for a comprehensive set of reforms directed toward school improvement. This year (the fifth year of the program), the assessment will proceed in much the same way it has during the previous years, with a few refinements.

The assessment program is administered by the Division of Educational Assessment of the Department of Educational and Cultural Services, with the cooperation of the Division of Curriculum and the Division of Special Education. Assisting state personnel is the contractor for the 1989-90 assessment, Advanced Systems in Measurement and Evaluation, Inc. of Dover, New Hampshire.

The Maine Educational Assessment is a more comprehensive statewide testing program than previously operated in Maine, and one with aspects making it unique among testing programs nationally. The question-and-answer section of this guide is intended to provide general information about the assessment program and more specific information regarding test content to educators and interested persons throughout the state.

What Are the Goals of the Program?

As mandated by the legislation, the assessment program is designed to achieve these goals:

- provide information on the academic achievement and progress of Maine students;
- establish a process for continuing evaluation of state educational goals and aid in the development of educational policies, standards and programs;
- provide school officials with information to assess the quality, effectiveness and appropriateness of educational materials, methods and curriculum needs, including remediation and enrichment;
- provide school staffs with information about individual students which may be used, with other information, to meet individual educational needs of the student;
- identify year-to-year trends in student achievement; and
- provide parents with information about the achievement of their children on the assessment tests.

How and When Will the Tests Be Administered?

At various times during this school year, Advanced Systems, the contractor for the assessment, will contact superintendents and building principals to collect the information necessary to conduct the testing. The tests are designed to be administered by teachers and will require a total testing time of approximately five to six hours divided among several separate testing sessions.

Manuals for test coordinators and administrators will provide detailed instructions for the processing of materials and the administration of the tests. Additionally, training sessions will be conducted in various locations in Maine prior to the testing dates at the different grade levels.

The testing periods for the 1989-90 school year are:

Grade 8 - October 23 to November 3, 1989
Grade 4 - January 22 to February 2, 1990
Grade 11 - March 26 to April 6, 1990

The actual dates of testing within these periods are to be determined by district personnel. They may schedule testing sessions any time during the first week of the two-week period provided they adhere to the guidelines provided in the instruction manuals. The second week should be reserved for make-up testing of students absent during the regular testing sessions.

Who Will Take the Tests?

All Maine public school students in grades 4, 8, and 11, and students approved for tuition purposes, will be tested. Exceptional students requiring testing modifications will be tested in accordance with the policies and procedures in the document titled *Maine Educational Assessment: Policies and Procedures for Modifications and Exclusions*. Exclusions from testing will be minimized and well-documented.

How Are the Tests Developed?

The development of the MEA tests is a cooperative effort by staff members in the Division of Educational Assessment and the Division of Curriculum, a contractor for the assessment, and curriculum advisory committees composed of teachers, curriculum specialists, and administrators from across the state. There is a separate advisory committee for each subject area tested, and each committee meets between eight and twelve times during the year for purposes of test development and results interpretation. Development tasks include the review and reevaluation of objectives/reporting categories; the review, revising, selection, and rejection of test questions; and the recommendation of new questions to "fill gaps" in the coverage of the content domains. A later section of this document describes the type of testing used by the MEA (i.e., the MEA design). It suffices to say here that hundreds of questions are used in a subject at a grade level (except in writing). Each year, approximately one-quarter to one-third of the questions are replaced. The contractor for the assessment, under the supervision of the Division of Educational Assessment, is responsible for field testing questions, assigning questions to test forms, and producing the final materials.

How Does the MEA Relate to Other Tests a District Might Use?

The answer to this question is not a simple one. In response to the question, the discussion that follows differentiates the various kinds of tests used by educators and describes many of the factors that should be considered in designing a district testing program.

STANDARDIZED (GENERAL) ACHIEVEMENT MEASURES

These tests produce student-level, norm-referenced total test scores (e.g., reading, math) and major subtest scores (e.g., comprehension, study skills, computation, concepts, problem solving). In conjunction with other information, these scores are useful for making placement decisions at the individual student level and for determining the relative strengths of different classes of students passing through a school.

Because of the tests' general nature (being designed for the general population of students and not producing results on specific, identifiable skills), the scores are less susceptible to change due to instruction than one might hope for from an achievement measure. The lack of variability of reported average or median student scores for schools; the lack of detailed categories for which scores are reported; and many factors related to the norming procedures, performance changes nationally, etc. make these tests of limited use for evaluating the effectiveness of local programs. Also, because the tests are designed for the general population of students, only a few test questions discriminate among students at a particular ability level. Thus, other measures, or at least additional information, should be used for identifying students requiring special remediation or qualifying for gifted programs, etc.

BASIC SKILLS OR MINIMAL COMPETENCY TESTS

These tests are generally used to identify students who fail to meet minimal standards of performance. Their questions address a limited number of skills considered to be basic and often reflect lower cognitive processes. Skill level information is usually not provided since the emphasis in reporting is on the identification of students scoring above or below a "cut score." While the numbers of students passing or failing such a test are of some use in program evaluation, these results do not reflect program effectiveness in terms of the broader curriculum and in terms of the majority of students who pass the tests.

MASTERY TESTS AND DIAGNOSTIC TESTS

Mastery tests include repeated measures of each of a limited number of specific skills. For example, a mastery test might include four very similar questions addressing the same skill and define mastery of the skill as success on three of the four questions. Thus, these tests are designed to identify the skills mastered or not mastered by individual students. Diagnostic tests, instead of including similar questions addressing a skill, include questions covering subskills and underlying concepts of skills in order to identify more specific deficiencies of individual students. Mastery and diagnostic tests are useful for managing instruction that focuses on the needs of individuals. While they yield far more than a total

test score and do not necessarily emphasize lower level skills, they are like basic skills tests in that they cover a small portion of a curriculum area.

LOCALLY DEVELOPED TESTS

For purposes of discussion in this guide, locally developed tests include two main categories of tests — classroom tests and school/district accountability tests. The focus of classroom tests is material recently taught. While concerns about the quality of teacher-made tests have often been raised, the grades teachers assign to students at the end of marking periods based primarily on these tests are highly reliable and valid. This is because, during the course of a marking period, teachers administer many tests and use other indicators of student performance as well. Psychometric deficiencies in a portion of these measures would be of little consequence in the fair assigning of grades. Of course, teachers appropriately use classroom tests as diagnostic tools, too.

School or district-wide accountability testing takes many different forms - usually one of those described above. The impetus for a district to develop its own tests is often dissatisfaction with the coverage of the local curriculum provided by commercial, published tests.

THE MAINE EDUCATIONAL ASSESSMENT

The MEA combines two types of testing. A common set of test questions in reading and math is administered to every student at a grade level statewide. These questions compose standardized (general) achievement measures as described previously.

There are many different test forms administered at a grade level in the MEA, each student completing only one form. In addition to the "common" questions used to generate student-level scores, each form contains a portion of a much larger set of questions in each of five major subject areas. This enables school scores to (1) be based on much more comprehensive coverage of subject domains and (2) be broken down into scores for several, more specific subdomains. For more information on this technique of testing, called matrix sampling, the reader is directed to the *Guide to the Maine Educational Assessment, 1988-89*. Of the types of testing discussed thus far, this one is most suited to program evaluation.

DISTRICT TESTING CONSIDERATIONS

While participation in the MEA is state-mandated, other testing programs are not. Decisions regarding the use of other tests are not easy ones to make. All of the types of testing described above can be useful, but overtesting of students must be a concern. Some districts minimize student testing time by using different tests in different grades. For example, MEA testing would be done at grades 4, 8, and 11 as required; standardized achievement testing might be done in different grades; and local accountability testing might be done in still different grades.

The utility of test results should be the major factor when deciding to adopt or continue a particular testing program. If results are going to be filed without being used, instructional time and money is wasted. Duplication of effort might be a related concern. If results of mastery or diagnostic tests are used little because they provide little new information to teachers in identifying specific needs of students, then these types of testing might be low in priority. Other considerations are discussed below.

Internal vs. external evaluation. Measuring students' capabilities with respect to local objectives and attending to what is happening within the district is a worthwhile endeavor. This is internal evaluation. However, it is also useful to know what "could be" or what "is" in schools serving similar populations of students. Decisions regarding what content might be added, deleted, or replaced in a curriculum can be facilitated by external evaluation.

Of the types of testing described above, only the MEA offers this type of external perspective by providing very broad coverage of content domains and by reporting results to which local results can be compared. Standardized (general) achievement measures have an external perspective in terms of scores (student percentile ranks) but do not report scores in specific subdomains which would help in determining program strengths and weaknesses. While basic skills/minimal competency tests, mastery tests and diagnostic tests might provide results for external groups, they deal with limited numbers of skills which any district would acknowledge as being covered in their curriculum, but which represent only a small portion of the curriculum. Comprehensive program evaluation makes use of both internal and external evaluation.

Program vs. Student Orientation. Except for the "matrix sampled" portion of the MEA (and perhaps a few district tests), all of the types of tests described above are designed to assess students, not instructional programs. This orientation is manifested not only in the way their results are reported, but also in the way the tests are constructed.

The general achievement measures do not include enough questions to yield scores for specifically defined areas within a subject. Average or median student scores for schools are not as reliable as the student scores themselves, and thus, do not discriminate strong from weak programs particularly well. Basic skills, minimal competency, mastery, and diagnostic tests provide poor coverage of a district's total curriculum, let alone the larger domains that might be covered by external evaluation instruments designed for statewide or national use.

Large numbers of questions are not necessary to rank-order students or to determine competency levels for a few skills. On the other hand, for program evaluation, breadth of coverage is important. Fortunately, once a decision has been made to focus on programs instead of students, certain efficiencies can be achieved — e.g., reduced testing time through matrix sampling.

A common criticism leveled at tests today is that they lead to a narrowing of the curriculum. Of course a test designed to assess a broadly defined domain can hardly be accused of narrowing the curriculum. Furthermore, tests don't narrow the curriculum; people do. If a district chooses to focus most of its attention on low-level basic skills, then the students are being shortchanged. The evidence showing the limitations of skill-mastery instruction continues to grow. Mastery of computational and other mathematical skills does not make a student a good problem solver. Drill in applying traditional reading comprehension skills in isolation has little payoff as well. Although basic skills tests exist and can be used to support a narrow "basics" program, it seems that a better program might use basic skills tests to identify students who are at risk and a different kind of test to evaluate the effectiveness of the broader curriculum.

Another testing issue often raised pertains to the relative merits of multiple-choice versus open-ended testing. The multiple-choice format is frequently criticized for failing to accommodate higher order thinking. The critics should be careful not to mistake the failure to ask the right questions for limitations of test item format. Multiple-choice questions can assess higher order and critical thinking skills well. If a test is to separate better thinkers from poorer thinkers, then the multiple-choice format can be effective. There is no question that open-ended testing can provide additional useful information for improving programs and diagnosing weaknesses in individual students. For that reason, the emphasis on multiple-choice testing should vary depending on the level and purpose of testing. Heavy dependence on multiple-choice testing at the classroom level would probably be a big mistake.

How Are the MEA Results Reported and How Can We Use Them?

The real understanding of test results requires some detective work. The testing program can provide test scores and related data, but local school personnel are the only ones who can uncover explanations of results. As might be inferred from the earlier discussion of different types of testing programs, the MEA has been designed to fill a large gap in the body of information most districts might use for program evaluation.

GENERAL RESULTS

The first few pages of data in the MEA school and district reports describe the groups of students (both local and statewide) whose scores counted and did not count toward the school scores. They also give a general overview of local performance relative to various points of comparison. This information should be of most interest to school and district administrators and school board members as well as to persons "outside" the district. For internal use within a district, it is most important that school personnel understand the general results and use them as a context for the interpretation of the more specific information provided later in the reports. They must search the general results for unexpected data and make every effort to explain why the results appear as they do.

State Averages, Comparison Score Bands, and Score Changes. The school reports provide comparative information in three forms: state average scaled scores, Comparison Score Bands, and previous local scores. Every school's results on test questions are aggregated to produce a total school score in a subject area. Because of comparability problems associated with simple percents correct, the school scores are transformed to another scale, still preserving the original rank-ordering of schools. The result of this transformation during the first year of the MEA was a statewide average score of 250 and a standard deviation (a measure of the spread of a score distribution) of 50 in every subject. Since the first year, statewide averages have varied slightly to reflect real change as measured by subsets of the questions administered in two successive years. If one considers statewide performance as a reasonable "standard" for comparison, then the statewide averages that appear near the local results in the school reports can be helpful.

In some instances, a statewide average might be considered an inappropriate standard for the population served by a particular school system. For this reason the MEA reports include Comparison Score Bands, which reflect the performance of groups of students similar to those in a particular school in terms of various background factors — primarily socioeconomic factors. A common misperception is that a school's Comparison Score Band describes the performance of specific, identifiable schools with similar background factors. This is not true. After school scores are computed, the mathematical relationship between these scores and schools' background factor indexes in the form of an equation is determined. Then to compute an estimated score for a school based only on background factors, the school's background factor indices (also reported in the school reports) are substituted into the equation, yielding the center score of the Comparison Score Band. Score limits above and below that figure are produced so that the resulting band would capture the middle 50 percent of school scores if there were a large number of schools with exactly the same background factors.

Some educators have expressed the concern that Comparison Score Bands reflect different expectations for different groups of students — something that should be avoided. When students enter a school, they bring with them many different characteristics, some related to academic performance and over which schools and teachers have no control. For example, students with different levels of parental education also probably have different attitudes toward school and education and experience different levels of parental encouragement and interest in their school work. Communities with more highly educated parents probably put more money into the education of every student in the community. Thus, it is not that different expectations should be advocated, but rather that some schools serve populations with

characteristics inhibiting achievement, and these characteristics should be taken into account when evaluating program effectiveness. A similar standard against which to compare scores would be inappropriate for New York City and Scarsdale, NY.

By including MEA scores for several years in a school report, it is possible to monitor changes in performance. However, a great deal of caution must be taken in interpreting change. Because the MEA assesses performance of students after they have experienced a school's program for several years, it is not likely that changes in curriculum and instruction will lead to immediate, observable changes in MEA scores. When substantial changes in a school's scores occur, some other possible explanations should be investigated. First, the relative academic abilities of the different classes of students passing through the school must be considered. Year-to-year fluctuations in the abilities of the students tested are often the explanation of fluctuations in MEA scores. Actually, since one year's group of students tested is just a sample of the students served by a school's program, then a better estimate of program effectiveness could be obtained by combining results for several samples. For this reason the MEA reports three-year cumulative averages.

Related to the "different abilities" explanation of score changes are changes in the representation of different groups in the computation of school scores. Some of the ablest students failing to take a portion of the test battery, or a larger proportion of special education students taking the test can have some impact on scores. (However, these problems are more likely to be factors in small schools.) To validate such explanations of results, one need only turn to the reports of individual student results or to the first page of school data describing the students tested and not tested.

Another possible explanation of score changes is differences in administration practices. These changes in practices could pertain to the general testing environment (large group vs. small group) as well as to errors in administration or the encoding of information on answer sheets.

PROGRAM DIAGNOSTIC AND SUBGROUP INFORMATION

Perhaps the most valuable information for evaluating curriculum and instruction is reported in the Diagnostic Display section of the MEA school reports. This is where school scores in objective areas and subareas within each major subject are reported. In the display, the score points are in the center of horizontal bars. The bars run from one standard error of measurement below the school score to one standard error above. The width of the bars depends, in part, on the number of test items and the number of students; larger numbers of either correspond to shorter bars. Shorter bars mean that ability estimates are more accurate because they are based on a larger sample of students from the student population and a larger sample of questions from the larger content domain. When two bars do not "overlap," the difference between the two scores is great enough to be considered significant.

Whether a school scores near the top or bottom of a statewide distribution of schools, it has areas of relative strength or weakness within its own curriculum. An easy way to identify such areas is to draw a vertical line at the point corresponding to the school score on the total test in a subject. The bars that do not cross the vertical line and are completely to the left and right of it represent relative weaknesses and strengths respectively.

An understanding of information included in the MEA reports is necessary but not sufficient for making effective use of the test results. It is most important that teachers and curriculum specialists within a school or school system, once they have identified strengths and weaknesses, do a great deal of detective work to understand the reasons behind student performance. To identify these reasons, they must seek information from a variety of sources, some of which are identified below:

- test content information beginning on page 7 for the different reporting categories;
- local curriculum guides or scopes and sequences for information on the intended curriculum in the school/district;
- teachers for information on the actual curriculum and on other aspects of instruction;
- the subgroup results in the MEA school reports for information on how the school or district compares to the state on variables that relate to achievement;
- the MEA Item Level Class Reports in reading and math for specific results that may illustrate more general patterns; and
- results of other testing programs producing relevant information.

The subgroup results section of the MEA school reports can be used as more than an information source for explanations of relative strengths and weaknesses. Sometimes overall school results on a test appear reasonable yet results for subgroups of students could reveal inequities in the performance of the different subgroups. Thus, subgroup results can be useful in identifying shortcomings of a school's program that are not detectable from total group scores.

A few cautions should be conveyed regarding the use of MEA data (or any other test results) in curriculum decision making. First, the MEA represents just one source of information. Findings should be corroborated. Second, areas appearing to be areas of weakness in only one year are not as likely to be true areas of weakness as areas identified as weaknesses in more than one year. Third, giving more attention to one area shown to be weak may be taking attention away from other areas. This may result in little change in total test performance. The best way to improve total test scores is to provide better instruction in areas already covered.

It should be clear from the discussion above that the MEA can provide a wealth of information useful in reviewing and evaluating local curricula. However, the MEA data is best used to help identify questions that must be answered before appropriate decisions can be made regarding curriculum change. Many sources of information must be used to find the answers.

What Content within the Different Subject Areas Do the Tests Cover?

The MEA tests are constructed to be consistent with broader conceptual frameworks developed by the various advisory committees to the program. The following sections describe the objectives frameworks for the different content areas, give the rationale underlying them, and identify reporting categories — i.e., the subtests for which scores will be reported. Sample items are included to illustrate the different kinds of thinking that are required by the test questions. Additionally, this section lists concepts, topics, and skills that characterize or define the domain corresponding to each reporting category. While test items may change from year to year, the basic content of the tests will remain consistent.

Reading

The reporting categories that will be used in the reporting of individual and school reading results are shown below.

Comprehension
- Literary Passages
- Content Passages
- Practical Passages

Reader Management
- Strategies
- Reference Skills

Long Passages
Short Passages

Traditional reading tests reflect a narrow view of reading that emphasizes specific skills and ignores the reader's active role in constructing meaning from a passage. The reading portion of the MEA is designed to assess student performance on two broad objectives: 1. The student comprehends what is read. 2. The student manages the reading experience. The MEA's broad reading objectives allow the flexibility to pose questions prompted naturally by the passages rather than being bound to a rigid quota of specific skills. The MEA's attention to reader management recognizes the roles of the reader's prior knowledge and repertoire of reading strategies in comprehension. These broad objectives are consistent with recent views of reading as a holistic and interactive process by which readers construct meaning, both from the passage and from the various kinds of background knowledge they bring to the task of reading the passage.

Comprehension

Comprehension questions represent a wide range of levels of inference:

1. **literal comprehension/textually explicit (reading the lines):** The answer is stated explicitly within the text. (No inference is required.) The range of difficulty of these items reflects the complexity of the text which must be scanned for the answer.
2. **inferential comprehension/textually implicit (reading between the lines):** The answer is implied by the text. These items require the student to combine several pieces of information in the text to derive the answer.
3. **inferential comprehension/scriptally implicit (reading beyond the lines):** The answer cannot be found in the text. These items require a response based on relevant prior knowledge gained from experience, perceptions, and a storehouse of mental scripts.

The emphasis in the MEA is clearly on inferential comprehension — reading is more than simply locating information. Approximately half of the comprehension questions pertain to textually implicit information, and another quarter of the items pertain to scriptally implicit information. Whether questions test literal or inferential comprehension is independent of item difficulty. Locating information can be difficult if the passage is complex. At the same time, some inferences can be quite obvious. Some sample questions are discussed below to illustrate the differences among the three types of comprehension.

> PASSAGE SUMMARY: A grade 8 passage previously used in the MEA describes the ancient Japanese fishing method by which teams of fishermen, headed by the U-jo, use long-necked, diving birds called cormorants.

That the firelight is used to attract the fish is stated in the passage; hence the answer to the first question is textually explicit. Several sentences describe the many tasks the U-jo must accomplish at the same time, allowing the reader to infer appropriately that the U-jo's job is "complicated," the correct response to the second question (textually implicit). To determine the correct response to question 3 (scriptally implicit), the reader must make an inference that is not so direct. Success on this item most likely results from a combination of good evaluative skills and exposure to ceremonial behaviors, the importance of tradition in different cultures, and perhaps even fishing. It is not likely that a head wrap would attract fish; further it was stated that firelight was used to accomplish that. Thus, option A could be eliminated. Frightening the cormorants (option B) would probably be undesirable and counterproductive to the task at hand. It is likely that shapes other than the strange shape of a swimming cormorant would provide as much protection for the U-jo; therefore, option D could be eliminated. Thus, evaluative skills could be used to reject the incorrect

QUESTION 1	QUESTION 2	QUESTION 3
The firelight is used to A. light the boatmen's way. B. attract the fish. C. warm the fishermen. D. entertain the tourists.	Which of the following words **best** describes the job of the U-jo? A. exciting B. complicated C. dangerous D. monotonous	The dark blue head wrap worn by the U-jo is **probably** shaped like the silhouette of a cormorant because it A. helps to attract the fish. B. frightens the cormorants. C. is worn to honor the cormorant as well as protect the U-jo. D. is the shape that provides the best protection for the U-jo.

answers. Additionally, the passage conveyed the importance of tradition effectively in many ways. Knowing that this method of fishing is used primarily as a tourist attraction (as stated in the text) and is not the predominant technique employed by modern Japanese fishermen, and knowing of the importance of traditional ceremonial costumes by peoples celebrating their pasts and their cultures, a knowledgeable reader should be drawn to the correct third response.

The non-multiple-choice question shown below was also used in the MEA:

> This ancient fishing method probably cannot compete with more modern commercial fishing methods. Explain why the cormorant fishermen continue to use this ancient method.

A weaker reader, relying more on the text and less on prior knowledge and broader, abstract thinking, might give a response dealing more with cormorant fishing as a tourist attraction since the text described it as such. A stronger student might include the importance of tradition in his or her response. (Both responses would be scored as correct.)

Reader Management

The reader management questions fall into two categories — reading strategy questions and reference skill questions. Strategy questions pertain to the information that a student might use to make decisions about how to approach a reading task as well as to the students' awareness of appropriate strategies and techniques to use in different situations. Thus, strategy items may require students to:

UNDERSTAND
- the purpose of a passage
- the structure of a passage
- the author's tone, style, and choices concerning content
- the purpose of adjunct aids such as charts, pictures, end-of-chapter questions, etc.
- the purpose of text cues such as bold face type, italics, etc.

RECOGNIZE
- relevant prior knowledge that would aid comprehension

PREDICT
- passage content or structure based on an understanding of genre, purpose, early passage clues, etc.

SELECT
- a reading strategy appropriate to the reader's purpose and genre
- strategies to solve comprehension problems (e.g., self-checking questions, ways to refind, review, remember ideas)

Reference skill questions require students to:
- identify passage genre
- select appropriate sources of information
- use reference materials

Sample strategy questions (one pertaining to a pamphlet on toxic waste in the home and the others to a newspaper article on a lake monster) are shown below.

Passages

The reading portions of the MEA tests require students to read both long and short passages from literature, the content areas, and practical sources. Literary passages represent a variety of forms — biography, drama, essay, novel, poetry, short story. Content passages are clearly informational and are taken from such sources as science and social studies textbooks as well as from information-dense articles in newspapers and magazines. Practical passages are functional materials leading the reader to an immediate action — directions, reference tools, manuals.

The passages selected for the MEA differ somewhat from those found in traditional reading tests. They reflect the advisory committee's belief that a reading test should be based on real-life reading tasks students could encounter in their classrooms and in their personal lives. The MEA passages often include pictures and graphics, and many are much longer than traditional test passages. Every effort is made to choose quality passages which represent a range of reading materials in the literary,

QUESTION 4

(TOXIC WASTE) This pamphlet is designed to be kept as a handy reference in the home. If you needed tips on disposing of leftover paint, the best strategy for referring to the pamphlet would be to

A. read the entire pamphlet to be sure you do not miss important information.
B. scan the entire pamphlet looking for the word "paint."
C. scan the section labeled "Disposal" for tips on paint.
D. first check to see if paint is pictured at the top of the list of tips.

QUESTION 5

(LAKE MONSTER) The first paragraph of this passage makes you believe the passage will

A. present opposing views on the issue.
B. express the author's view and present evidence for that viewpoint.
C. poke fun at those who believe in Ogopogo.
D. criticize those who doubt Ogopogo's existence.

QUESTION 6

(LAKE MONSTER) After reading the three opening paragraphs, what is the best question you could ask yourself to check your understanding?

A. How many Ogopogo sightings occurred last summer?
B. Where is Lake Okanagan?
C. What is the connection between tourist season and Ogopogo sightings?
D. How is Ogopogo similar to the Loch Ness monster?

Mathematics

The development of the mathematics portion of the MEA tests was guided by the following content-by-process matrix.

CONTENT

PROCESS	Numbers and Numeration	Variables and Relationships	Geometry	Measurement	Problem-solving Skills	Probability and Statistics
Conceptual/Knowledge						
Procedural						
Problem Solving						

The row and column headings in the matrix above are MEA reporting categories — i.e., subtests for which separate school scores will be reported. (Only the process headings serve as reporting categories for individual student results.) Later in this section on mathematics, detailed lists of concepts, topics, and skills that help define the content categories are listed separately for each grade level.

The cognitive process dimension is similar to that used in previous years of the MEA. The **conceptual/knowledge** category pertains primarily to specific, static information — the facts, linkages of ideas, and understandings of concepts a student has at his or her command at a particular time. Test questions assigned to this category require the use of memory processes or the ability to translate, explain, exemplify, or model ideas.

Procedural knowledge is general, consisting primarily of production rules. Test questions in this category require students to execute procedures (e.g., computational algorithms), give reasons for steps of a procedure, and recognize correct and incorrect procedures.

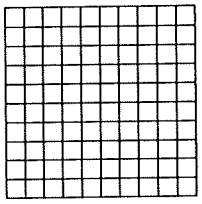
Problem solving generally requires combining the other two kinds of knowledge or cognitive processing. Proficiency in this area is demonstrated by success at solving routine and nonroutine, one-step and multistep word or story problems. Also, questions in this category require students to demonstrate problem-solving skills (perform steps along the way to a solution) without performing all the steps necessary to arrive at an answer. For example, students might be asked to identify missing and extraneous information, identify and perform the next step in a partially solved problem, select the most efficient strategy for solving a problem, and verify solutions through analysis of procedures or through estimating answers or evaluating their reasonableness.

Sometimes the assignment of test questions to process categories is not so clear-cut. One reason for this would be the differences among students in different grades or of different ages. For example, "6 x 8 = ?" would be "conceptual/knowledge" for a student once he or she has memorized the basic multiplication facts. However, for a student who does not yet know the basic facts, the task could be considered "procedural." Similarly, "$\sin^2 a + \cos^2 a = ?$" would be "conceptual/knowledge" for an advanced student who has memorized the trigonometric identities, while it would be "problem solving" for a student who has only been introduced to the basic trigonometric functions in a geometry course.

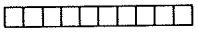
GRADE 4 SAMPLE QUESTIONS

Postage stamps come in sets of one hundred stamps, ten stamps, five stamps, and single stamps.

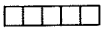
This is a set of 100 stamps:



This is a set of 10 stamps:

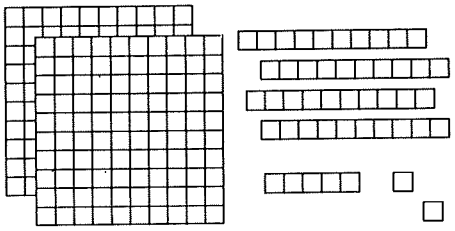


This is a set of 5 stamps:



This is a single stamp:

Below are the stamps that you purchased. How many did you get?



A. 2,470
B. 2,047
C. 247
D. 147

PROCESS: Conceptual

Find the sum:

28 + 497 + 4 + 56 + 238 =

A. 623
B. 823
C. 819
D. 1975

PROCESS: Procedural

Write a math word problem that uses all four of the following measurements: 11 inches, 14 inches, 18 inches, and 21 inches.

PROCESS: Problem Solving

GRADE 8 SAMPLE QUESTIONS

What number would you put in the box to make the number sentence true?

$7 \times 9 = (7 \times \square) + (7 \times 3)$

A. 3
B. 6
C. 9
D. 42

PROCESS: Conceptual

Compute: $3\frac{5}{7} + 5\frac{3}{4} =$

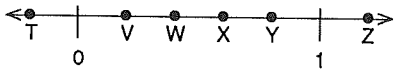
A. $8\frac{8}{28}$
B. $8\frac{8}{11}$
C. $8\frac{13}{28}$
D. $9\frac{13}{28}$

PROCESS: Procedural

Each time a ball bounces, it rebounds $\frac{1}{2}$ the height from where it begins to drop. If the ball is dropped from a height of 72 feet, what is the total distance the ball will have traveled by the fourth time it hits the ground?

PROCESS: Problem Solving

GRADE 11 SAMPLE QUESTIONS



If points W and X on the number line above are simple fractions, which point could be their product?

A. Point T
B. Point V
C. Point Y
D. Point Z

PROCESS: Conceptual

24 is 16 percent of what number?

A. 384
B. 150
C. 38.4
D. 15

PROCESS: Procedural

There are 16 students in a science class. On the day of the last test, 4 students were absent. The class average of those who took the test was 74. When the absent students made up the test, their scores were 68, 79, 96, and 85. What is the new class average?

PROCESS: Problem Solving

Concepts, Topics, and Skills

GRADE 4

NUMBERS AND NUMERATION

Numeration

- translate numerals into words and vice versa
- order whole numbers
- order decimal numbers
- place value
- translation of pictures into numerals (e.g., base-10 figures)
- round to the nearest ten
- round to the nearest hundred
- recognize simple fractional parts and their unions
- recognition of =, <, > signs
- expanded notation

Number Theory

- completing or recognizing number patterns
- even and odd numbers
- common multiples (e.g., counting by 3's and 5's)
- set membership given diagrams
- relations and their signs (equality, inequality, simple transitivity)

Operations - Whole Numbers

- addition involving up to 5-digit numbers
- subtraction involving up to 5-digit numbers
- multiplication involving up to 3-digit numbers

GRADE 8

NUMBERS AND NUMERATION

Numeration

- decimal place value
- order fractions and decimals
- round 5-digit whole numbers
- round decimals
- understand concept of fraction as division
- recognize shaded areas as fractional parts (simple fractions)
- recognize shaded areas as fractional parts - decimal and percent
- read number lines (decimal numerals/interpolation)

Number Theory

- determine greatest common factor
- determine least common multiple
- prime numbers
- property of closure in a number system

Operations - Whole Numbers

- exponents
- add and subtract large numbers
- multiply 3-digit numbers by 2-digit numbers
- divide by 1- and 2-digit divisors

GRADE 11

NUMBERS AND NUMERATION

Numeration

- order fractions and decimals
- round to nearest hundred
- round to nearest hundredth, thousandth
- recognize fractional parts (shaded areas) - simple fractions
- recognize fractional parts (shaded areas) - decimal fractions
- recognize fractional parts (shaded areas) - percents
- read number lines/interpolate
- scientific notation

Number Theory

- compute greatest common factor, least common multiple/denominator
- prime numbers
- set membership
- even and odd numbers
- property of closure in a number system

Operations - Whole Numbers

- exponents
- square roots (concept of)
- add and subtract large numbers
- multiply 2-digit numbers by 3-digit numbers

Grade 4	Grade 8	Grade 11
- division facts (e.g., 42 ÷ 6) - division of 1-digit number into 3-digit number - number sentences with missing addends - routine word problems involving addition and subtraction - non-routine word problems involving addition and/or subtraction	- order of operations - simplify expressions with grouping symbols - routine word problems (1-step & 2-step, all operations) - non-routine word problems	- divide by 2-digit divisors - order of operations - simplify expressions with grouping symbols - routine word problems (all four operations; one-step and multi-step) - non-routine word problems
	Operations - Fractions - translate simple fractions into decimals - add and/or subtract simple fractions with unlike denominators - add and/or subtract mixed numerals - multiply and/or divide simple fractions - find a fractional part of whole numbers - multiply mixed numerals - solve routine 1-step or 2-step word problems requiring addition, subtraction, multiplication or division of fractions - solve non-routine word problems involving fractions	**Operations - Fractions** - translate simple fractions into decimals - determine least common denominator - add and/or subtract simple fractions with unlike denominators - add and/or subtract mixed numerals with unlike denominators - multiply/divide fractions and mixed numerals - solve routine word problems requiring addition, subtraction, multiplication or division of fractions (one-step and multi-step) - solve non-routine word problems involving fractions
Operations - Decimals - addition of decimal numerals without the presence of dollar signs - addition and subtraction of decimals with dollar signs - one-step word problems involving money - two-step word problems involving money (e.g., How much change. . .)	**Operations - Decimals** - translate decimals into simple fractions - add/subtract numbers with varying numbers of decimal places - multiply numbers with varying numbers of decimal places - divide numbers with varying numbers of decimal places - understand repeating decimals - solve routine word problems involving decimals	**Operations - Decimals** - translate decimals into simple fractions - add/subtract numbers with varying numbers of decimal places - multiply numbers with varying numbers of decimal places - divide numbers with varying numbers of decimal places - understand repeating decimals - solve routine one-step and multi-step word problems involving money (including consumer problems)
	Operations - Percent - translate simple fractions into percentages - compute percentage - solve routine word problems requiring the computation of percentages	**Operations - Percent** - compute percentages - solve routine one-step and multi-step word problems requiring the computation of percentages (including consumer problems) - solve non-routine word problems involving the computation of percentages
	Operations - Integers - add/subtract integers - multiply/divide integers - solve routine word problems involving integers	**Operations - Integers** - add/subtract integers - multiply/divide integers - solve routine word problems involving integers
Properties of Operations - multiplying by zero - application of commutative property	**Properties of Operations** - demonstrate understanding of distributive, commutative, and associative properties (knowledge of terminology not required)	**Properties of Operations** - demonstrate understanding of distributive, commutative, and associative properties (knowlege of terminology not required)
	VARIABLES AND RELATIONS **Equations/Inequalities** - find missing addends - solve simple algebraic equations and inequalities - simple substitution questions	**VARIABLES AND RELATIONS** **Equations/Inequalities** - simplify algebraic expressions - sustitution problems - translate word problems into equations

Grade 4	Grade 8	Grade 11
	- translate words into equations and algebraic expressions - solve simple problems that lend themselves to writing equations - transitivity of relations **Functions/Coordinate Systems** - find the coordinates of a point - understand transitive property - determine rules/patterns (equations) - recognize number patterns	- analyze relationships of variables in equations - solve algebraic equations - solve inequalities - solve simple problems that lend themselves to writing equations **Functions/Coordinate Systems** - find the coordinates of a point - find slope of a line (given a graph) - graph equations and inequalities - determine rules/patterns (given table of ordered pairs) - recognize number patterns - recognize characteristics of lines from their equations
GEOMETRY **Plane and Solid Figures** - number of angles/sides in basic plane figures - recognize basic plane figures/polygons - recognize similar shapes - diagonals	**GEOMETRY** **Plane and Solid Figures** - distinguish among types of quadrilaterals - recognize basic solid shapes - apply knowledge of 360 degrees in a circle - estimate the size of an angle - recognize congruent figures - use properties of circle - select correct construction - recognize line of symmetry **Properties of Triangles** - use proportionality of similar triangles to find lengths - determine missing angles of triangles - understand and apply properties of different types of triangles	**GEOMETRY** **Plane and Solid Figures** - distinguish types of quadrilaterals - recognize common solid figures - apply knowledge of 360 degrees in a circle - estimate the size of an angle - recognize congruent figures - select correct construction - recognize line of symmetry **Properties of Triangles** - use proportionality of similar triangles to find lengths - determine "missing" angles of triangles - understand and use properties of different types of triangles
Spatial Visualization - blocks needed to complete larger block - recognize symmetric figures - recognize result of cutting solid shapes (solid/cross sections) - recognize rotated figures - paper folding and cutting/symmetry	**Spatial Visualization** - sections of solids (shapes of cross sections) - faces of solid figures from different perspectives	**Spatial Visualization** - sections of solids (shapes of cross sections) - faces of solid figures from different perspectives
Perimeter, Area, and Volume - compute perimeter of a rectangle - compute area of a rectangle - determine number of small blocks in larger rectangular solid (given picture)	**Perimeter, Area and Volume** - compute circumference - solve word problem involving perimeter - compute the area of a rectangle - compute the area of a circle (given π) - compute the area of a right triangle - use unit squares to determine the area of an irregular figure - compute the area of shaded portions of a figure - solve word problems requiring the computation of area - solve word problems requiring the computation of volume	**Perimeter, Area and Volume** - compute circumference - compute the area of rectangles and triangles - use unit squares to determine the area of an irregular figure - solve word problems requiring the computation of perimeter or area - solve word problems requiring the computation of volume
MEASUREMENT **Using Instruments** - read ruler to nearest whole and 1/2	**MEASUREMENT** **Using Instruments** - read protractors	**MEASUREMENT** **Using Instruments** - read protractors

Grade 4	Grade 8	Grade 11
inch - read ruler to nearest centimeter - estimate length in centimeters - read clocks - read thermometers - estimate distance on map using a key - read scale	- read clocks - determine elapsed time - read thermometers - read rulers to the nearest quarter inch	- determine elapsed time - read thermometers, scales, and other instruments - read rulers to the nearest quarter inch
Unit Equivalents - relationship between measurement and size of measurement unit - translate months into years and months - translate inches into feet and inches - money - elapsed time - word problems involving time	**Unit Equivalents** - solve word problems using non-standard units - determine unit equivalents within the metric system - determine unit equivalents within the English system - solve problems involving time and length - use scale drawings	**Unit Equivalents** - solve word problems using non-standard units - determine unit equivalents within the metric system - determine unit equivalents within the English system - solve problems involving time and length - use scale drawings
Appropriate Units - appropriate English unit for length of an object - appropriate metric unit for length of an object - appropriate English unit for volume of liquid - appropriate metric unit for volume of liquid - appropriate English unit for weight of an object - appropriate metric unit for weight of an object	**Appropriate Units** - select the appropriate metric unit for measuring a particular linear distance - appropriate units for perimeter, area, volume	**Appropriate Units** - select the appropriate metric unit for measuring a particular linear distance - appropriate units for perimeter, area, volume
PROBLEM-SOLVING SKILLS **Estimation/Reasonableness** - estimate height or length of familiar objects in feet - estimate height or length of familiar objects in meters - estimate the total cost of several items (prices given) - estimate reasonable answers to problems with insufficient data to actually compute an answer - estimate the length of a curved line - demonstrate understanding of how to estimate	**PROBLEM-SOLVING SKILLS** **Estimation/Reasonableness** - estimate a linear distance in centimeters - select the most reasonable answer to a problem in which insufficient information is given to actually compute an answer - estimate the answer to word problems - demonstrate understanding of how to estimate	**PROBLEM-SOLVING SKILLS** **Estimation/Reasonableness** - estimate a linear distance in centimeters - select the most reasonable answer to a problem in which insufficient information is given to actually compute the answer - estimate the answer to word problems - demonstrate understanding of how to estimate
Understanding the Problem/Reasoning - summarize problems - select the question that has the same answer as another word problem - analyze if-then statements	**Understanding the Problem/Reasoning** - summarize problems - select the question that has the same answer as another word problem - analyze if-then statements	**Understanding the Problem/Reasoning** - summarize problems - select the question that has the same answer as another word problem - analyze if-then statements
Strategies - select the table that would help to solve a particular problem - select the number sentence that could be used to solve a word problem - select the best operation for solving a problem - select the picture that represents a problem	**Strategies** - select the most appropriate operation to solve a problem - select the next step or series of steps that could be used to solve a problem - identify the appropriate table, equation or diagram one might use to solve a problem	**Strategies** - select the most appropriate operation to solve a problem - select the next step or series of steps that could be used to solve a problem - identify the appropriate diagram one might use to solve a problem

Grade 4	Grade 8	Grade 11
Relevant Information - determine which information in a problem is not necessary - determine what additional information is necessary to solve a problem	**Relevant Information** - determine which information is not required to solve a problem - determine what additional information is needed to solve a problem	**Relevant Information** - determine which information is not required to solve a problem - determine what additional information is needed to solve a problem
PROBABILITY AND STATISTICS - spinner problems with probability related to areas of regions - simple combinations - read and use calendars - read charts - interpret charts (e.g., most, fewest, etc.) - read pictographs using a key - read line graphs - interpret line graphs (e.g., most, fewest, etc.) - draw conclusions from graphs - read and interpret bar graphs	**PROBABILITY AND STATISTICS** - spinner problems with probability related to areas of regions - determine probability of spinning a given number - compute simple combinations and permutations - compute the average of 5 numbers - demonstrate understanding of average as a measure of central tendency - find median - read line, bar, circle graphs and charts - determine output of flow chart - interpret line, bar, circle graphs and charts (i.e., draw conclusions) - select the appropriate graph for data given in tabular form	**PROBABILITY AND STATISTICS** - spinner problems with probabilty related to areas of regions - determine probability of spinning a given number - compute simple combinations and permutations - compute the average of 5 numbers - demonstrate understanding of average and median as measures of central tendency - read line, bar, circle graphs and charts (i.e., locate data) - determine output of flow chart - interpret line, bar, circle graphs and charts (i.e., draw conclusions) - select the appropriate graph for data given in tabular form

ESSENTIAL MATHEMATICS FOR THE TWENTY-FIRST CENTURY

The Position of the National Council of Supervisors of Mathematics

Introduction

Students who enter kindergarten in 1988 can expect to graduate from high school in the year 2001. Yet these students who will graduate in the twenty-first century still frequently face a computation-dominated curriculum more suitable for the nineteenth century. To address this inconsistency, the National Council of Supervisors of Mathematics (NCSM) now updates its 1977 basic skills position statement to describe the essential mathematical competencies that citizens will need to begin adulthood in the next millennium. This position by NCSM is intended to complement and support positions on mathematics education by the National Council of Teachers of Mathematics and other professional groups.

Our technological world is changing at an ever-increasing rate, and our responsibilities in international affairs continue to increase. As the demands of society change, so do the essential competencies needed by individuals to live productively in that society. All students, including those of all races and both sexes, will need competence in essential areas of mathematics.

What Is Essential?

The NCSM views as "essential" those competencies that are necessary for the doors to employment and further education to remain open. Essential mathematics, as described in this paper, represents the mathematical competence students will need for responsible adulthood.

The students we educate today can expect to change jobs many times during their lifetimes. The jobs they hold will develop and change around them. Often, specific job skills will not transfer from one position to another. To prepare for mobility, students must develop a thorough understanding of mathematical concepts and principles; they must reason clearly and communicate effectively; they must recognize mathematical applications in the world around them; and they must approach mathematical problems with confidence. Individuals will need the fundamental skills that will enable them to apply their knowledge to new situations and to take control of their own lifelong learning.

Skill in whole-number computation is not an adequate indicator of mathematical achievement. Nor is it sufficient to develop skills apart from their applications or to memorize rules without understanding the concepts on which they are based. Students must understand mathematical principles; they must know when and how to use computation; and they must develop proficiency in problem solving and higher-order thinking.

The NCSM position statement of 1977 responded to the "back-to-basics" movement with its overly narrow conception of basic skills. Now, as we look to the future, we recognize that the use of calculators and computers and the application of statistical methods will continue to expand. Creative problem solving, precise reasoning, and effective communication will grow in importance. To function effectively in the next century, students will need proficiency in an enriched body of essential mathematics. The list that follows identifies twelve critical areas of mathematical competence for all students. It does not imply an instructional sequence or a priority among

topics. In fact, the twelve essential mathematics areas are interrelated; competence in each area requires competence in other areas.

TWELVE COMPONENTS OF ESSENTIAL MATHEMATICS

Problem solving

Learning to solve problems is the principal reason for studying mathematics. Problem solving is the process of applying previously acquired knowledge to new and unfamiliar situations. Solving word problems in texts is one form of problem solving, but students also should be faced with nontext problems. Problem-solving strategies involve posing questions, analyzing situations, translating results, illustrating results, drawing diagrams, and using trial and error. Students should see alternate solutions to problems; they should experience problems with more than a single solution.

Communicating mathematical ideas

Students should learn the language and notation of mathematics. For example, they should understand place value and scientific notation. They should learn to receive mathematical ideas through listening, reading, and visualizing. They should be able to present mathematical ideas by speaking, writing, drawing pictures and graphs, and demonstrating with concrete models. They should be able to discuss mathematics and ask questions about mathematics.

Mathematical reasoning

Students should learn to make independent investigations of mathematical ideas. They should be able to identify and extend patterns and use experiences and observations to make conjectures (tentative conclusions). They should learn to use a counter-example to disprove a conjecture, and they should learn to use models, known facts, and logical arguments to validate a conjecture. They should be able to distinguish between valid and invalid arguments.

Applying mathematics to everyday situations

Students should be encouraged to take everyday situations, translate them into mathematical representations (graphs, tables, diagrams, or mathematical expressions), process the mathematics, and interpret the results in light of the initial situation. They should be able to solve ratio, proportion, percent, direct variation, and inverse-variation problems. Not only should students see how mathematics is applied in the real world, but they should observe how mathematics grows from the world around them.

Alertness to the reasonableness of results

In solving problems, students should question the reasonableness of a solution or conjecture in relation to the original problem. Students must develop the number sense to determine if results of calculations are reasonable in relation to the original numbers and the operations used. With the increase in the use of calculating devices in society, this capability is more important than ever.

Estimation

Students should be able to carry out rapid approximate calculations through the use of mental arithmetic and a variety of computational estimation techniques. When computation is needed in a problem or consumer setting, an estimate can be used to check reasonableness, examine a conjecture, or make a decision. Students should acquire simple techniques for estimating such measurements as length, area, volume, and mass (weight). They should be able to decide when a particular result is precise enough for the purpose at hand.

Appropriate computational skills

Students should gain facility in using addition, subtraction, multiplication, and division with whole numbers and decimals. Today, long, complicated computations should be done with a calculator or computer. Knowledge of single-digit number facts is essential, and using mental arithmetic is a valuable skill. In learning to apply computation, students should have practice in choosing the appropriate computational method; mental arithmetic, paper-pencil algorithm, or calculating device. Moreover, everyday situations arise that demand recognition of, and simple computation with, common fractions. In addition, the ability to recognize, use, and estimate with percents must also be developed and maintained.

Algebraic thinking

Students should learn to use variables (letters) to represent mathematical quantities and expressions; they should be able to represent mathematical functions and relationships using tables, graphs, and equations. They should understand and correctly use positive and negative numbers, order of operations, formulas, equations, and inequalities. They should recognize the ways in which one quantity changes in relation to another.

Measurement

Students should learn the fundamental concepts of measurement through concrete experiences. They should be able to measure distance, mass (weight), time, capacity, temperature and angles. They should learn to calculate simple perimeters, areas, and volumes. They should be able to perform measurement in both metric and customary systems using the appropriate tools and levels of precision.

Geometry

Students should understand the geometric concepts necessary to function effectively in the three-dimensional world. They should have knowledge of such concepts as parallelism, perpendicularity, congruence, similarity, and symmetry. Students should know properties of

simple plane and solid geometric figures. Students should visualize and verbalize how objects move in the world around them using such terms as slides, flips, and turns. Geometric concepts should be explored in settings that involve problem solving and measurement.

Statistics

Students should plan and carry out the collection and organization of data to answer questions in their everyday lives. Students should know how to construct, read, and draw conclusions from simple tables, maps, charts, and graphs. They should be able to present information about numerical data, such as measures of central tendency (mean, median, mode) and measures of dispersion (range, deviation). Students should recognize the basic uses and misuses of statistical representation and inference.

Probability

Students should understand elementary notions of probability to determine the likelihood of future events. They should identify situations in which immediate past experience does not affect the likelihood of future events. They should become familiar with how mathematics is used to help make such predictions as election results, business forecasts, and outcomes of sporting events. They should learn how probability applies to research results and to the decision-making process.

CLIMATE FOR LEARNING

To learn the essential mathematics needed for the twenty-first century, students need a nonthreatening environment in which they are encouraged to ask questions and take risks. The learning climate should incorporate high expectations for all students, regardless of sex, race, handicapping condition, or socioeconomic status. Students need to explore mathematics using manipulatives, measuring devices, models, calculators, and computers. They need to have opportunities to talk to each other about mathematics.

Students need modes of instruction that are suitable for the increased emphasis on problem solving, applications, and higher-order thinking skills. For example, cooperative learning allows students to work together in problem-solving situations to pose questions, analyze solutions, try alternative strategies, and check for reasonableness of results.

To implement the new instructional strategies, extensive professional development opportunities as well as new learning materials will be needed.

from *Arithmetic Teacher*

Science

The development of the science portion of the MEA tests was guided by the following content-by-process matrix.

PROCESS	CONTENT: Scientific Inquiry	Life Science	Earth/Space Science	Physical Science
Knowledge/Comprehension				
Application/Higher Order				

The row and column headings in the matrix above are MEA reporting categories — i.e., subtests for which separate school scores will be reported. The content categories are broken down further into more specific reporting categories that are shown as subheadings in the list of concepts, topics, and skills covered by the MEA presented later in this section. That list serves to define the science content categories better for each grade level.

The process dimension is used to assure that the test questions cover a full range of cognitive processes. The categories are hierarchical. **Knowledge** questions require primarily memory processes (factual recall). **Comprehension** questions involve translations or explanations of concepts, principles, etc. **Application** questions require students to apply their knowledge or understanding of general concepts to particular situations. **Higher order** questions require students to analyze, synthesize, or evaluate information.

The knowledge or understanding of scientific content required by students to answer questions in the category of "Scientific Inquiry" is either minimal or so basic that most students would have sufficient relevant background on the topic for them to respond successfully provided they have the skills being assessed by the questions. Scientific concepts are, of course, the focus of questions in the other content categories.

The sample questions below from various grade levels are presented as examples of questions addressing the different cognitive processes.

Chris wants to find out which of two laundry soaps is best. Chris washes two loads of dirty clothes. What should be different about the two loads?

A. the kind of clothes
B. the type of dirt
C. the temperature of the water
D. the brand of soap

CONTENT: Scientific Inquiry
PROCESS: Application

The source of energy for the earth's water cycle is

A. the earth's rotation.
B. radiation from the sun.
C. radiation from the earth's core.
D. the sun's gravity

CONTENT: Earth Science
PROCESS: Knowledge

Which of the following is **most likely** to contaminate the drinking water in a well in a family's back yard?

A. starting a compost pile nearby
B. fertilizing the lawn
C. throwing rocks into the well
D. building a toolshed nearby

CONTENT: Life Science
PROCESS: Higher Order

A nuclear-power reactor must be carefully monitored. It cannot, however, explode like an atomic bomb. Why?

A. The reactor turns itself off when it gets too hot.
B. The container of the reactor is too thick.
C. The nuclear reaction take splace too slowly in the reactor.
D. Uranium does not sustain fission.

CONTENT: Physical Science
PROCESS: Comprehension

Concepts, Topics, and Skills

Grade 4

SCIENTIFIC INQUIRY

Nature of Science & Scientific Inquiry

- how to improve a science study
- best way to study a science problem
- recognize relevant information needed
- best step or sequence of steps to investigate a problem
- sampling
- perceptions of scientists and science
- capabilities of technology

Grade 8

SCIENTIFIC INQUIRY

Nature of Science & Scientific Inquiry

- importance of replication of experiments in science
- perceptions of science and scientists
- experimental design/control (how to improve a study)
- use of models to solve problems
- match hypothesis to research questions

Grade 11

SCIENTIFIC INQUIRY

Nature of Science & Scientific Inquiry

- Importance of replication of experiments in science
- perceptions of science and scientists
- experimental design/control (how to improve a study)
- best way to study (empirical/non-empirical alternative)
- use of models to solve problems

Grade 4	Grade 8	Grade 11
- responsibility regarding harmful side effects - effects of science on society	- identify relevant and irrelevant variables - hypothesis vs. fact - effects of science and technology on society	- match hypothesis to research questions - identify relevant and irrelevant variables - concept of sampling - hypothesis vs. fact - effects of science and technology on society
Observing and Measuring - sorting, categorizing, classifying - sequencing of events/pictures - distinguishing observation from interpretation - measurement error/measurement not exact - quantities measured by instruments - appropriate measurement units - reading instruments - appropriate graph - techniques of summarizing data	**Observing and Measuring** - concept of sampling - classifying and sequencing - observation vs. interpretation - measurement error - appropriate measurement units - reading instruments - appropriate graph - scientific notation - methods of simplifying and summarizing data	**Observing and Measuring** - classifying and sequencing - observation vs. interpretation - measurement error - appropriate measurement units - reading instruments - scientific notation - methods of simplifying and summarizing data
Interpreting/Translating Data - read bar graphs - read line graphs - read circle graphs - read tables - interpolation/extrapolation - draw conclusions from data in graphs and tables - appropriate graph	**Analyzing and Interpreting Data** - read graphs and tables - interpolation/extrapolation - detecting patterns/relationships in data - appropriate generalizations and conclusions from graphs and tables - deductive logic - assumptions and arguments	**Analyzing and Interpreting Data** - read bar graphs - detecting patterns/relationships in data - appropriate generalizations and conclusions from graphs and tables - assumptions - deductive and inductive logic
LIFE SCIENCE **Characteristics of Life** - stages of development - heredity (inheritance of trait from parents) - biogenesis (i.e., like breeds like) - basic biological classifications (e.g., mammal, reptile) - basic life functions - levels of organism organization (e.g., cells, organs) - life cycles	**LIFE SCIENCE** **Characteristics of Life** - stages of development - basic life functions (e.g., respiration, photosynthesis) - Mendelian genetics, commercial uses of genetics, like breeds like - heredity - natural selection - cell division - characteristics of living things - levels of organism organization (e.g., cells, tissues, organs) - osmosis - biological classification	**LIFE SCIENCE** **Characteristics of Life** - stages of development - basic life functions (e.g., respiration, photosynthesis) - Mendelian genetics, commercial uses of genetics, like breeds like - heredity - natural selection - cell division - characteristics of living things - levels of organism organization (e.g., cells, tissues, organs) - osmosis - biological classification
Systems/Functions - nutrition/basic food groups - causes/nature of familiar diseases - disease prevention techniques - organ systems (respiratory, nervous, digestive, circulatory) - animal behavior (territoriality, instinct, hibernation, migration) - parts of plants - functions of plant parts - commercial uses of plants (e.g., cloth) - phototropism - requirements and products of photosynthesis	**Systems/Functions** - nutrition/basic food groups - causes/nature of diseases, disease prevention, AIDS - organ systems (respiratory, digestive, circulatory, reproductive) - animal behavior (e.g., territoriality, instinct, hibernation, migration, etc.) - health topics (drugs, cholesterol, high bood pressure) - plant structure and function - photosynthesis - microorganisms	**Systems/Functions** - nutrition/basic food groups - causes/nature of diseases, disease prevention, AIDS - organ systems (respiratory, digestive, circulatory, reproductive, nervous) - animal behavior (e.g., territoriality, instinct, hibernation, migration, etc.) - plant structure and function - photosynthesis - microorganisms
Ecology and Environment - decay - relationships between plants and insects	**Ecology and Environment** - decay - predator/prey relationships - food chains and webs	**Ecology and Environment** - decay - predator/prey relationships - food chains and webs

Grade 4	Grade 8	Grade 11
- relationships between plants and animals - predator/prey relationships - food chains/webs - ecological balance and ecosystems - pollution (causes and effects) - habitats	- ecosystems and ecological balance - energy cycle - greenhouse effect - energy in successive levels of food chain - stability of populations - pollution	- ecosystems and ecological balance - energy cycle - greenhouse effect - energy in successive levels of food chain - accumulation of substances in food chain - stability of populations
EARTH AND SPACE SCIENCE **Astronomy** - relative distances within our solar system - relative motion of bodies within our solar system - rotation/revolution - causes of day, night, seasonal changes - position of the sun and shadows - movement of the stars - conditions on the moon (e.g., no atmosphere, less gravity, etc.) - space exploration (distances, gravitation)	**EARTH AND SPACE SCIENCE** **Astronomy** - relative motion of bodies within solar system (including eclipses, moon phases, etc.) - rotation/revolution - seasonal changes - position of the sun and shadows - space exploration (distances, gravitation) - the Earth's atmosphere - conditions on the moon. - solar radiation - types of heavenly bodies - relative distances in space	**EARTH AND SPACE SCIENCE** **Astronomy** - relative motion of bodies within the solar system (including eclipses, moon phases, etc.) - rotation/revolution - seasonal changes - position of the sun and shadows - space exploration (distances, gravitation) - the Earth's atmosphere - conditions on the moon - solar radiation - types of heavenly bodies - relative distances in space
Meteorology - types of clouds - temperature and weather - humidity - weather prediction using simple weather maps - types of precipitation/storms - weather instruments - use of weather satellites	**Meteorology** - forms of precipitation - humidity and air pressure - movement of air masses - coastal vs. inland climates - weather prediction, weather instruments, weather satellites - climate	**Meteorology** - forms of precipitation - humidity and air pressure - movement of air masses - coastal vs. inland climates - weather prediction, weather instruments, weather satellites
Geology/Natural Resources/ Oceanography - land formations - changes in the Earth's surfaces - erosion - water cycle - fossils - earthquakes, volcanoes - natural resources (renewable, supply limitations) - tides - conservation - ocean waves - ocean life/habitats	**Geology/Natural Resources/ Oceanography** - land formations - changes in the Earth's surface - plate tectonics - erosion - water cycle - fossils - types of rocks - fossil fuels and U.S. energy consumption - natural resources other than fuel sources - tides - ocean waves - ocean life/habitats - characteristics of ocean water (e.g., salinity, density, etc.)	**Geology/Natural Resources/ Oceanography** - land formations - changes in the Earth's surface - plate tectonics - erosion - water cycle - energy cycle - fossils - types of rocks - fossil fuels and U.S. energy consumption - other natural resources - tides - ocean waves - ocean life/habitats - characteristics of ocean water (e.g., salinity, density, etc.)
PHYSICAL SCIENCE **Force and Motion** - simple machines - simple applications of Newton's laws - acceleration due to gravity/falling objects - relative motion - gravity	**PHYSICAL SCIENCE** **Force and Motion** - simple machines - applications of Newton's laws - acceleration due to gravity (falling objects) - friction - pendula - work/force/energy	**PHYSICAL SCIENCE** **Force and Motion** - simple machines - applications of Newton's laws - acceleration due to gravity (falling objects) - friction - pendula - work/force/energy
Energy - electrical safety - simple electrical circuits	**Energy** - simple electrical circuits/electricity - heat transfer	**Energy** - electrical circuits - heat transfer

Grade 4	Grade 8	Grade 11
- energy use/conservation - forms of energy - heat transfer - reflecting/absorbing light - shadows - light refraction - light reflection - sound energy - magnetism	- energy transformations - conservation of energy - characteristics of waves - reflecting/absorbing light - light refraction - light reflection - magnetism - nuclear energy	- energy transformation - conservation of energy - characteristics of waves - reflecting/absorbing light - light refraction - light reflection - magnetism - nuclear energy
Matter - physical and chemical changes - characteristics of metals - atoms - conservation of matter - states of matter - applications of gas laws (e.g., hot air balloon) - density of salt water vs. fresh water - evaporation/condensation	**Matter** - physical/chemical changes - combustion reactions - acids and bases - atomic structure - elements, compounds, mixtures, solutions - density - conservation of matter - states of matter - applications of gas laws	**Matter** - physical/chemical changes - combustion reactions - atomic structure - elements, compounds, mixtures, solutions - density - conservation of matter - states of matter/kinetic theory - applications of gas laws - specific heat - periodicity of elements/periodic chart - half-life - chemical equations

THE MEA AND YOUR SCIENCE PROGRAM

"Science for All Americans," the report from Project 2061 sponsored by the American Association for the Advancement of Science (1989) cites the need to make scientific literacy a national goal. The first phase of Project 2061 has established the conceptual base for achieving this goal by identifying the knowledge, skills, and habits of the mind that all students should have acquired by the time they finish high school. In brief the recommendations which address the basic dimensions of scientific literacy include:

- being familiar with the natural world and recognizing both its diversity and unity;
- understanding key concepts and principles of science;
- being aware of some of the important ways in which science, mathematics, and technology depend on one another;
- knowing that science, mathematics, and technology are human enterprises and knowing what that implies about their strengths and limitations;
- having the capacity for scientific ways of thinking;
- using scientific knowledge and ways of thinking for individual and social purposes.

The content and structure of the MEA science assessment are consistent with the broad recommendations of Project 2061. The pattern of results from the initial years of the MEA indicate that although Maine students compare favorably with their peers in the nation, performance does not meet the expectations of teachers or the goal of Project 2061 to achieve scientific literacy for all students.

Analysis of the MEA results at the school and district level over a multi-year period can be extremely useful in identifying the strengths and weaknesses of your science curriculum in achieving scientific literacy for all students. Your analysis of the results contained in the School Summary Report should include at least the following:

1. Development of a graphic representation of the performance by the broad content domains (scientific inquiry, life sciences, earth/space sciences, physical sciences) for each level tested (elementary, intermediate and secondary) across the four years of the assessment. (Results are found on page 9 of the School Summary Report.)
2. Examination of the sub-categories under the content domains for the most recent two years to provide more specific clues to performance strengths or weaknesses. (Also on page 9).
3. Creation of a table summarizing the number of students by percentage falling into each performance quarter for each level tested over the four years of the assessment. (Page 5).
4. Review of the results of the attitude, and study habit questions contained in the subgroup report for each level assessed over the four years of the assessment. (Pages 12-14).

As a basis for analyzing your science results, review the content outline of concepts and skills tested by the MEA presented in the Guide. Look for general trends, consistencies, and inconsistencies in performance rather than focusing on absolute statistical differences. Finally, remember that MEA as an assessment tool is only one measure of your program and you need to compare the results of your analysis with other testing information and your own observations. The judgments you make to modify or change your science curriculum or instructional approach should be based on those trends in performance which have been consistent over time and agree with your experience in the classroom.

Grade 4	Grade 8	Grade 11
- draw conclusions from graphs, tables, charts - identify bias - recognize assumptions - identify/analyze elements of sources - organize information	- distinguish between fact and opinion - evaluate evidence/draw inferences - recognize assumptions - identify main idea in political cartoons	- identify main idea in political cartoons - identify perspective/bias - recognize assumptions - evaluate evidence/draw conclusions - distinguish between fact and opinion/ value statements - recognize logical inconsistencies - recognize parallel situations

PURPOSES AND GOALS OF THE SOCIAL STUDIES

The mix of students in our schools and the pattern of their life experience have altered rapidly in recent years with the result that classrooms bring together young people of widely divergent backgrounds. Our nation is enriched by such diversity, so long as shared values from our past — especially devotion to democratic procedures for settling disputes and mutual tolerance — remain vigorous among us.

These circumstances require the social studies in our schools to cultivate good citizenship and encourage the growth of independent personalities, ready to conduct their lives in accord with ethical principles. This goal can only be achieved by exploring the principal group identities that compete for every person's loyalty, and examining how they interact and co-exist. These overlapping identities are best addressed historically, by exploring how human affairs have come to be the way they are. This requires study of: a) gender, class, religious and work-place roles; b) the evolving rights and responsibilities of citizenship in the U.S.; c) our varied cultural heritages and their interaction arising from membership in global society.

Study of these three levels of social life addresses basic questions: "Who am I?", "To what do I belong?", "How should I behave?", and "How have things changed, and how should they change in time to come?" Since these questions must, in practice, be answered by every young person, it follows that rigorous, systematic social studies are needed for successful transition from childhood to adult life, beginning in the primary grades and continuing throughout secondary school.

Goals of the Social Studies

The Social Studies Curriculum should enable students to:

1) See their own life experience as part of the larger human adventure in time and place

   - All individuals are connected with other people, the environment and society through a) economic institutions for allocating and distributing resources, b) political institutions for collective decision-making and public action, c) social institutions for community and group support, and d) an array of opportunities for personal development and expression.
   - These institutions operate within constraints and opportunities of environment, resources, social values, habits, and our human capacity to adapt.
   - History and geography, by emphasizing time and place, provide the indispensable framework for study of these relationships.

2) Understand the history, geography, institutions, traditions and values of the United States in all their unity and diversity.

   - The unity that holds our country together requires public knowledge and appreciation of the institutions that govern us. These institutions can work smoothly only when they are supported by shared attitudes and expectations that define the common good and set limits to selfish behavior on the part of individuals and groups. It follows that heartfelt recognition of the enormous public advantages that willing acceptance of legal restraints brings to our nation is vital for the continued health of democracy in the United States. Even more important is the affirmation and development of personal attitudes that sustain self government — tolerance of differences, acceptance of majority decisions, respect for the worth of the individual and for private and public property.
   - The diversity of the country requires exploration of how different sorts of Americans have striven for freedom and prosperity — sometimes cooperatively and sometimes forming groups in conflict with one another. Avoiding controversy and using up embarrassing episodes in our past must be resisted, for that encourages boredom and disbelief. Students see conflict and cooperation all around them and need to know that this has not always been the case.
   - In addition, the special experience of the U.S. must be set in the context of European and world affairs, so that our continuing involvement with other nations will be seen as normal and inescapable.

3) Understand other peoples and the unity and diversity of world history.

   - Acquaintance with ways of life different from our own ought to begin in the earliest grades. As

childish fascination with dinosaurs shows, things far away and long ago have special appeal to the imagination and can expand a child's horizons far beyond the confines of the immediate community. Enough class time to learn a lot about a few carefully chosen samples of human societies is better than superficial coverage.

- Yet sampling is not enough. What is needed is a vision of unity and diversity in world affairs similar to the unity and diversity we see in our own country. World history can be studied in this spirit, finding unity in the major breakthroughs that altered human life everywhere — the rise of agriculture, of civilizations, of the higher religions, of a global trade net, of democratic government, and of modern industrial and scientific technologies — while recognizing an on-going diversity and grounds for conflict in the many cultures and institutions through which human beings seek to achieve a good life for themselves.

4) Develop civic responsibility and insight.

- Experience of local affairs, together with sensitive investigation of social groupings that exist within the school itself, are an essential part of the social studies, and ought to engage students actively in school and local events, celebrations and community services.
- A combination of detachment and commitment to action is needed in a classroom approach to local social realities. Carefully maintaining a balance in teaching about the philosophies of different groups must be nurtured. Denying group differences and clashes of interest and purpose is pointless; understanding them and channeling their expression into peaceable and legal forms is the goal.
- This can best be achieved by comparing actualities with ideals and then seeking to close the gap that always exists, without embracing extremes on the one hand, or abandoning hope of improvement of the other.

5) Use the perspectives and methods of inquiry appropriate to history, geography and the social science disciplines.

- A cultivated mind must be able to grasp the fact that social realities change with time and place and shade off around the edges in such a way that stereotypes and summary judgements are misleading. Training in the social studies ought therefore to make students more tentative, and accurate in speaking about themselves and others and acting towards them, both in the classroom and in adult life.
- Knowledge of how individuals have exhibited heroism — not only political leaders but men and women from all walks of life — can help us raise our sights and grasp the glories and tragedies of human existence.
- Responsible management of human and natural resources requires public awareness of our place in the natural environment, and of our growing capability for altering, even destroying, global balances.

These are the characteristics and capabilities that mark human beings off from the rest of creation. Their achievement is the supreme end of education. Social studies play a central, indispensable part in attaining that goal. They can only do so when they are required of all students, taught by skilled and dedicated teachers, and allowed the necessary classroom time without unnecessary intrusions from other (quite legitimate) concerns.

By the Curriculum Task Force, National Commission on Social Studies in the Schools

Humanities

The MEA humanities test is based on the following objectives framework:

HUMANITIES AREA	Forms, Elements, and Techniques	Meaning and Purpose	Social/Historical Perspectives
Literature			
Visual Arts			
Performing Arts			
Language			
Religion/Philos.			

Each row and each column in the matrix above constitutes a reporting category for school level results. As in other content areas, items in the humanities matrix cover a wide range of cognitive processes. Additionally, the columns of the figure above represent progressively more involved understandings of the different areas within the humanities.

Forms, Elements, and Techniques includes items dealing with the recognition of various forms of literature, types or styles of art, and characteristics of different languages, religions, or philosophies. Items that associate tools or materials with an art form, or identify features or methods used in creating a literary or artistic work, would also be placed in this category. Items under **Meaning and Purpose** deal with the interpretation of literature, specific works of art, and philosophical concepts. Also covered are items identifying the purpose of various forms of literature and art and various religious practices, and items requiring students to compare and contrast types of literature, different works of art, differing forms of communication, and varying philosophical viewpoints. **Social and Historical Perspectives** items associate various aspects of the humanities with place or time in history or cultural origin. For example, they require that students associate famous authors/artists with their works, and place a variety of languages, religions, and philosophies or philosophers within the appopriate social reference or historical time frame. Influences of the humanities on society and history, and the effects of society and history on the humanities, are also covered. The three sample questions below illustrate these three categories.

The purpose of a folktale is to
A. persuade and convince through propaganda.
B. teach and amuse with a story.
C. inform and instruct with facts.
D. warn and frighten with opinions.
AREA: Literature
OBJECTIVE: Meaning and Purpose

Why do advertisers deliberately misspell words such as nite, kwik, and lite?
A. They believe consumers will not know the correctly-spelled words.
B. They wish to confuse the consumer.
C. They want to abbreviate or highlight the words.
D. They do not know how to spell them.
AREA: Language
OBJECTIVE: Meaning and Purpose

What is the origin of most of the music played by symphony orchestras in the United States?
A. Europe
B. Asia
C. North America
D. Africa
AREA: Performing Arts
OBJECTIVE: Social/Historical Perspective

If an artist wants an object to appear far away he could make it
A. smaller and place it at the bottom of the picture.
B. smaller and place it in the center of the picture.
C. larger and place it at the bottom of the picture.
D. larger and place it at the center of the picture.
AREA: Visual Arts
OBJECTIVE: Forms, Elements, and Techniques

Concepts, Topics, and Skills

Grade 4

LITERATURE

Forms, Elements, Techniques
- recognition of poem's rhyme scheme
- distinguish/characterize genre (poetry vs. prose; nursery rhyme, limerick, legend, fable)
- describe action or plot of fable
- predict resolution

Grade 8

LITERATURE

Forms, Elements, Techniques
- setting of story
- theme of story
- recognize literary devices (e.g., onomatopoeia, metaphor, simile, personification) in a poem
- recognize genre (e.g., limerick, fable)
- define periodical literature

Grade 11

LITERATURE

Forms, Elements, Techniques
- story theme, setting, etc. of story or poem
- recognize literary devices (e.g., onomatopoeia, simile, metaphor) in a poem
- recognize genre (e.g., limerick, fable)
- define periodical literature

Grade 4	Grade 8	Grade 11
	- associate literary form to performing art (script to play)	- recognize and associate forms of written expression (script to screenplay) - identify famous plays as comedy, tragedy, etc. - associate a list of quotes with a famous author - understand role of narrator
Meaning and Purpose - interpretation of age appropriate poetry - interpretation of myth - compare and contrast two short fairy tales - lesson in children's story - tone of poem - theme of poem	**Meaning and Purpose** - interpretation of poetry - tone of a poem - effect of poetic techniques on poem meaning - purposes of different genres (e.g., folktale)	**Meaning and Purpose** - interpret poetry - identify tone of a poem - understand effect of poetic techniques on the poem's meaning - understand purposes of different genres (e.g., folktale)
Social/Historical Perspectives - associate nursery rhymes with given purposes - identify author of famous children's books - characteristics of myths - extract poet's social statement from poem	**Social/Historical Perspectives** - identify author of famous quotation - understand role of literature in cultural transmission - identify famous poets - associate literary forms with their culture of origin. - associate famous quote with the societal concern it addresses	**Social/Historical Perspectives** - associate famous quote with speaker/writer - role of literature in cultural transmission - identify famous poets - understand common themes of famous works - associate literary genre/title with a historical period - associate a famous American author with his/her works
VISUAL ARTS **Forms, Elements, Techniques** - identify artistic medium creating particular product - identify medium used in the creation of a depicted artwork - identify different art forms (e.g., mobile, mosaic) - recognize rhythm and movement of abstract line drawings - associate names of geometric shapes with common objects - compare two works of art (style)	**VISUAL ARTS** **Forms, Elements, Techniques** - know tools of different visual artists - color families - clay techniques - recognize different styles of painting - identify artist's focus - outstanding feature - understand spatial concepts: balance, negative space, perspective - understand characteristics of photography as an art form - recognize drawing styles (e.g., gesture drawing, contour, perspective) - identify medium used to create a depicted work	**VISUAL ARTS** **Forms, Elements, Techniques** - know tools, media, and techniques of different visual artists - color families - recognize different styles of painting - identify artist's focus - outstanding feature - understand spatial concepts: balance, negative space, depth, foreshortening, perspective - understand characteristics of photography as an art form - recognize drawing types (e.g., gesture, contour, perspective) - correlate an art style with a musical style - understand mathematical foundation of many art processes
Meaning and Purpose - identify symbolism of the elements of the American flag - identify photographer's perspective or outstanding feature of photograph - purpose of Egyptian pyramids - main idea of a painting - purpose of totem poles - mood of painting - recognize artist's purpose - identify theme of famous American monuments	**Meaning and Purpose** - theme of depicted work(s) of art - understand original purpose of historic architectural structures - understand purpose of decoration on ancient functional pieces - infer architect's purpose from depicted structure	**Meaning and Purpose** - theme of a depicted work of art - understand original purpose of historic architectural structures - understand purpose of decoration on ancient, functional pieces - infer architect's purpose from depicted structure - compare two paintings (styles) - identify artist's purpose and main idea in a work of art

Grade 4

Social/Historical Perspectives
- associate a depicted work of art with its country of origin
- recognize offerings of an art museum
- recognize and interpret Native American art
- understand significance of cave drawings
- common feature in two famous architectural structures
- recognize Roman influence/origin in contemporary structures

PERFORMING ARTS

Forms, Elements, Techniques
- instrument families/classifications
- characteristic sound of particular instruments
- method of playing a particular instrument
- musical notation
- identification of depicted instrument
- associate a line of music with a familiar song title
- associate an instrument with a type of music
- identify basic components of ballet, opera, etc.
- associate jargon with artist type
- purpose of musical forms

Meaning and Purpose
- uses of particular instruments throughout history
- setting and characterization from a brief play excerpt
- interpretation of a pictorial mime sequence
- understand job of a director
- importance of costumes, props, lighting, etc. to play production
- purpose of chant and dance in Native American culture

Social/Historical Perspectives
- classify famous composers
- identify the national anthem by name
- associate types of performers with period in history
- associate costumes with a historical period
- social function of symphony concert

Grade 8

Social/Historical Perspectives
- associate a depicted historic architectural structure with a culture or a religious group
- associate a depicted sculpture with a culture
- associate a depicted work of art with a period in art history or artist
- identify characteristics of classic architecture of ancient civilizations
- associate words with a period of history
- evolution of languages
- predominant language/second language in regions

PERFORMING ARTS

Forms, Elements, Techniques
- understand aspects of stage direction
- function of stage direction in particular excerpt from play
- role of the play director
- understand a diagram of acting space on stage
- identify musical symbols
- understand musical concepts/terminology
- associate musical instruments with a type of music
- categorize familiar tune as a particular musical form
- associate titles with types of performance (e.g., ballet, opera)
- basic components of opera, ballet, pantomime, etc.
- understand range of singing voices

Meaning and Purpose
- effects of stage lighting
- setting, characterization in play excerpt
- meaning/effect of using particular instruments
- understand music differs culture to culture

Social/Historical Perspectives
- instrument families
- origins of particular types of music
- associate types of dance with time period
- recognize names of composers
- associate famous performers with their craft
- recognize famous American composers
- identify early entertainers in American radio/TV history

Grade 11

Social/Historical Perspectives
- associate a depicted historic architectural structure with a culture or a religious group
- associate a depicted sculpture with a culture
- associate a depicted work of art with a period in art history or a particular artist
- identify characteristics of classical architecture of ancient civilizations
- associate a depicted textile or rug with a culture
- associate an art historical period with its theme or philosophy
- identify original function of art/artifacts

PERFORMING ARTS

Forms, Elements, Techniques
- understand aspects of stage direction/stage diagram
- function of stage direction in particular excerpt from play
- identify musical symbols and understand musical concepts/terminology
- associate musical instruments with a type of music
- categorize familiar tune as a particular musical form
- associate titles with a type of musical performance (e.g., ballet, opera)
- characteristic components of opera, ballet, pantomime, etc.
- instrument families
- identify elements of particular musical forms, e.g., opera
- correlate motif in music to theme in literature

Meaning and Purpose
- effects of stage lighting
- setting, characterization in play excerpt
- meaning/effect of using particular instruments
- understand music differs culture to culture
- purpose of dance (e.g., square dancing for participation)

Social/Historical Perspectives
- origins of particular types of music
- associate types of performing arts with time period
- recognize names of performers in different areas
- associate famous performers with their craft or time period
- associate famous composers with a style of music (e.g., church)
- origin of Broadway musical
- identify early entertainers in radio/TV history

Grade 4

LANGUAGE

Forms, Elements, Techniques

- how new words evolve
- special sounding word clusters (e.g., tongue twisters)
- associate jargon with domain
- identify forms of nonverbal communication
- comprehend components of a dictionary entry
- know basic characteristics of hieroglyphics
- associate language references with the purposes

Meaning and Purpose

- rationale and meaning of highway signs
- rationale and meaning of international symbols
- rationale and meaning of trail signs

Social/Historical Perspectives

- predominant language/second language in regions
- concept of regional accents
- identify words borrowed from other languages or associate borrowed words with a culture
- identify common feature in several alphabets

RELIGION/PHILOSOPHY

Forms, Elements, Techniques

- recognize religious and non-religious holidays
- associate religious holidays with the appropriate religion
- recognize structures as places of worship
- associate church titles with religious functions

Meaning and Purpose

- recognize a person's philosophy from a short passage

Grade 8

LANGUAGE

Forms, Elements, Techniques

- different forms of communication (e.g., nonverbal, sign language, Braille, etc.)
- derivation of words incorporated into the English language
- meaning of literacy
- basic elements of hieroglyphics
- recognize an excerpt from a thesaurus
- recognize slang

Meaning and Purpose

- purposes of the dictionary
- message of a depicted mime sequence
- impact of context on verbal messages
- rationale/meaning of highway signs
- advertiser's propaganda techniques
- role/limitations of the interpreter
- how language defines what is important in a culture

Social/Historical Perspectives

- recognition of linguistic chauvinism
- importance of literacy in world relations
- why English is the national language
- concept of regional accents
- predominant language/second language in regions
- evolution of languages over time
- identify words borrowed from other languages or associate borrowed words with a culture

RELIGION/PHILOSOPHY

Forms, Elements, Techniques

- associate holidays with a particular religious group
- recognize structures as places of worship
- define morals
- recognize names of Greek and Roman gods
- identify the sacred books of different religions
- recognize basic plot of famous myth
- understand function of anthems
- identify musical forms used in religious worship

Meaning and Purpose

- associate a poem with a culture and its philosophy

Grade 11

LANGUAGE

Forms, Elements, Techniques

- different forms of communication (e.g., nonverbal, sign language, Braille, etc.)
- derivation of words incorporated into the English language
- meaning of literacy
- basic elements of different forms of written languages (e.g., hieroglyphics)
- recognize an excerpt from a thesaurus, parts of a dictionary entry, etc.
- recognize slang, formal English

Meaning and Purpose

- purposes of the dictionary
- message of a depicted mime sequence
- impact of context on verbal messages
- rationale/meaning of highway signs
- advertiser's propaganda techniques
- role/limitation of the interpreter
- how language defines what is important in a culture

Social/Historical Perspectives

- recognition of linguistic chauvinism
- importance of literacy in world relations
- why English is the national language
- concepts of regional accents
- associate words with a period of history
- evolution of language/vocabulary
- origin of technical terms of a profession
- language groups (e.g., Romance)
- classify a set of common symbols as part of a specialized language (e.g., mathematics)
- predominant language/second language in regions
- identify common feature in several alphabets

RELIGION/PHILOSOPHY

Forms, Elements, Techniques

- associate holidays with a particular religious group
- recognize structures as places of worship
- define morality; ethics
- recognize names of Greek and Roman gods
- identify the sacred books of different religions
- recognize basic plot of famous myth
- understand function of anthem (national, religious)
- meaning of reincarnation
- common goals of most religions

Meaning and Purpose

- understand significance of religious symbols

Grade 4	Grade 8	Grade 11
- recognize fallacies in reasoning from short passage - understand purpose of hymns in religious services - understand a person's philosophy from stated information - draw conclusion from brief passage	- understand effects of Communism on religion - interpret a philosophical phrase - recognize the purposes served by mythology - interpret brief statement from the Constitution - define atheism - apply a given philosophy to a scenario and make prediction - select the Buddhist principle which applies to given Jataka tale	- associate a poem with a culture and its philosophy - understand effects of Communism on religion - interpret a philosophical phrase - recognize the purposes served by mythology - define atheism, agnosticism, etc. - apply a given philosophy to a given scenario and make predictions - interpret basic philosophy expressed in an excerpt from a famous American document - understand the basic conflict of creationism versus Darwinism
Social/Historical Perspectives - understand philosophy of the founding fathers of our government - associate a basic tenet with a religion - know importance and location of Jerusalem - know major religions of regions (e.g., Middle East)	**Social/Historical Perspectives** - associate famous people with significant events in history of religion - associate a religion with a country of origin or its founder - associate a brief philosophy with a culture - understand importance of and location of Jerusalem - understand 1500s Protestant break with the Catholic church - associate a prominent composer with religious music - understand concept of freedom of religion - identify basic attitudes/philosophies of Native Americans - compare religious philosophies (Humanism vs. Christianity vs. Judaism) - know major religions of different regions	**Social/Historical Perspectives** - associate famous people with significant events in history of religion - associate a religion with a country of origin - associate a brief philosophy with a culture or historic group (i.e., Pilgrims) - understand importance of and locate religious centers - understand 1500s Protestant break with the Catholic church - understand freedom of religion - know major religions of different regions - identify basic attitudes/philosophies of Native Americans - identify the Puritan philosphy of education - recognize Constantine's adoption of Christianity in Roman times

The Humanities in America

The humanities help us to reflect on the fundamental question: What does it mean to be human? The humanities offer clues but never a complete answer. They reveal how people have tried to make moral, spiritual and intellectual sense of a world in which irrationality, despair, loneliness, and death are as conspicuous as birth, friendship, hope and reason. We learn how individuals or societies define the moral life and try to attain it, attempt to reconcile freedom and the responsibilities of citizenship, and express themselves artistically. The humanities do not necessarily mean humaneness, nor do they always inspire the individual to engage in some noble action.

The humanities presume particular methods of expression and inquiry — language, dialogue, reflection, imagination, and metaphor. In the humanities the aims of these activities of mind are not geometric proof and quantitative measure, but rather insight, perspective, critical understanding, discrimination, and creativity. These aims are not unique to the humanities, but are found in other fields, in images from the arts, and in new forms of expression created by film, television, and computers. No matter how large their circle, however, the humanities remain dedicated to the disciplined development of verbal, perceptual, and imaginative skills needed to understand experience.

A popular response to the high rate of illiteracy among high school graduates, the "back to basics" movement marks a return to the utilitarian tradition in American education. For the humanities, "back to basics" is a mixed blessing. Improving the reading and writing skills of students is a goal of and a foundation for study in the humanities. But wherever basic education concentrates exclusively on the three R's, or whenever academic achievement is reduced to what can be measured by standardized testing, the humanities are likely to be misunderstood as expendable frills. The notion that the humanities improve the mind, nurture the spirit, and inform moral and civic choices can be all but lost in the rush "back to basics."

To reject or ignore the humanities in the name of literacy would be a tragic mistake. Americans have traditionally set loftier goals for education than the acquisition of basic skills alone, and simply eliminating illiteracy will not restore public confidence in the schools.

A free society depends on citizens who are broadly educated. The humanities form a bridge between functional literacy and the higher intellectual and civic purposes of learning. Study of the humanities is also a personal kind of learning, answering a need that grows out of particular experience. Whatever a student's background, the humanities help clarify questions of moral, social, and aesthetic value that each individual encounters throughout learning and life. By showing young people how others have searched for meaning in their lives, the humanities help them think critically about themselves and their place in the world.

In acquiring skills in native and foreign languages, students learn logic, classification, and comparison. These conceptual skills are no less basic than literacy itself. They enable young people to go beyond merely functional tasks to wonder, imagine, and decide what is good, what is enjoyable, how their lives should be lived. The arts, companions to the humanities, awaken young people to the possibilities of human expression, sharpen their senses, and introduce them to cultural traditions through study of, and participation in, literature, music, the visual arts, theater, and dance. Education in the arts is more than a sampling of "great works" or modes of self-expression. It also helps students sense the aesthetic dimensions of their everyday lives.

Many young people today lack confidence in the future. Their cynicism is a growing reflection of our failure to solve persistent social problems and our growing awareness of limited material resources. In times of economic uncertainty, young people are often urged to prepare for earning a livelihood and discouraged from studying the humanities. We can ill afford to starve the spirit that moved each younger generation to search for humane solutions to perennial human problems and unprecedented ones alike. The humanities contain that spirit. In the humanities our children will find examples of courage and resilience in the face of moral challenge or technological change. Through the humanities they can develop capacities for judgment and discrimination, as well as the curiosity and imagination to go beyond what has been thought, said, and done before: basic skills for the creation of a future.

Our children must not be denied the strength that is drawn from the ideals of the past. It is this strength that will help them face a future in which revolutionary changes — already foreshadowed by today's technology — will demand old and new capacities for thought and communications. Our young people today are detached in many ways from the literary and historical bases of culture that past generations took for granted. They therefore need, probably more than any generation before them, clear and convincing evidence of the duration of human culture and reassurance that they are a living part of that culture.

From The Humanities in American Life
Report of the Commission on the Humanities

APPENDIX A: MEA Content Advisory Committees

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APPENDIX B: MEA Technical Information

After each of the first two years of the MEA, a technical summary was produced providing test quality information and explaining the design of the program and how data were analyzed and reported. Since much of the information in those documents remains applicable, the reader should refer to one of them for a better understanding of the technical characteristics of the MEA. The purpose of this section of the MEA Guide is to update the information on test reliability and validity.

Reliability

Test reliability is the extent to which test results are consistent. A reliability coefficient answers the question, "If we administered the test again, how similar would the results be for the first and second administrations?" Reliability coefficients reported by commercial test publishers are indicators of the reliability of individual student scores, not school scores. This is appropriate since most of the commercial tests are designed for student-level reporting. Mean or median student scores for schools based on these tests do not generally have a reliability coefficient reported for them. The MEA school scores are not simply average student scores, but rather are an aggregation of a school's results on the test questions — a large number of test questions in each subject area since matrix sampling accommodates such. The reliability coefficients for 1988-89 school scores are computed with schools as the unit of analysis and are shown below:

Coefficient Alpha (Schools)

Subject	Grade 4	Grade 8	Grade 11
Reading	.96	.97	.97
Mathematics	.95	.96	.97
Science	.93	.93	.95
Social Studies	.95	.96	.96
Humanities	.91	.93	.93

Individual student scores in reading and mathematics are based on only the fifty or fewer items in each of those areas that all students answer. The reliability coefficients for 1988-89 grade 4, 8, and 11 student scores are .86, .87, .89 in reading and .88, .90, and .92 in mathematics.

The reliability associated with writing scores is examined differently. Each student writes an essay on one of two topics. (Each topic is assigned to approximately half of the students in every school.) Each essay is scored independently by two scorers assigning ratings from 1 to 6 for each of six attributes. Differences greater than one in the corresponding ratings of the two scorers are adjudicated by a table leader. Differences of only one point are not adjudicated because such differences are not necessarily problematic; in fact, they are seen as appropriate for "borderline" papers since the two ratings are summed in producing a student's score on an attribute.

Perhaps the best indicator of interrater reliability for the scoring process is the adjudication or arbitration rate of two percent that is obtained overall for the scoring of writing samples. This arbitration rate is based on the total number of attributes scored (six per composition). Under eight percent of the compositions have at least one attribute for which the ratings are arbitrated. Of course, unreliability of raters in terms of differences in ratings by more than one point is corrected through the process of adjudication.

Validity

Test validity is the extent to which a test is measuring what it is supposed to measure. There are many forms of validity. For a longer discussion of this topic than appears in this brochure, the reader should consult one of the MEA technical summaries. "Content" validity, which relies heavily upon expert judgment, is largely the responsibility of the MEA assessment advisory committees. During test development, these groups of Maine teachers and curriculum specialists make decisions about the appropriateness of test questions for inclusion in the assessment instruments.

"Construct" validity is demonstrated by evidence that test scores behave as expected. At a general level, local school personnel can investigate construct validity by answering the question, "Are my stronger students outscoring my weaker students on the MEA?" While there are always exceptions when one is considering a single test score for individual students, the general pattern of MEA results supports an affirmative response to this question. Another important place to look for evidence of construct validity is in the subgroup results section of the MEA school reports. There one can examine the associations between performance on the different MEA tests and variables such as parental education, gender, course backgrounds, attitudes toward a subject, etc. Those associations are as one should expect.

For purposes of "concurrent" validation, student scores in reading and math have been correlated in the past with scores on the ITBS, STEP, CTBS, and SRAs. The results of these analyses are shown below:

Correlation between MEA Scores and Selected Tests

	Reading			Mathematics		
Test	Gr. 4	Gr. 8	Gr. 11	Gr. 4	Gr. 8	Gr. 11
Iowa Test of Basic Skills (TAP at Gr.11)	.77 n=555	.80 n=676	.78 n=749	.82 n=560	.85 n=677	.81 n=770
Sequential Test of Educational Progress	.76 n=860	.79 n=930	.80 n=919	.81 n=865	.85 n=936	.86 n=917
Comprehensive Test of Basic Skills	.79 n=235	.79 n=264	— —	.80 n=235	.80 n=265	— —
SRA Survey of Basic Skills	.73 n=150	.80 n=102	.73 n=120	.74 n=150	— —	.86 n=120

Test validity is not so easily reduced to numbers. Validity depends not only on statistical considerations, but also on the use to which the test results are put. A valid test designed for one purpose may be invalid for another. For example, a test of minimal competencies would be of limited validity and value as a sole indicator of the effectiveness of a district's curriculum and instruction.