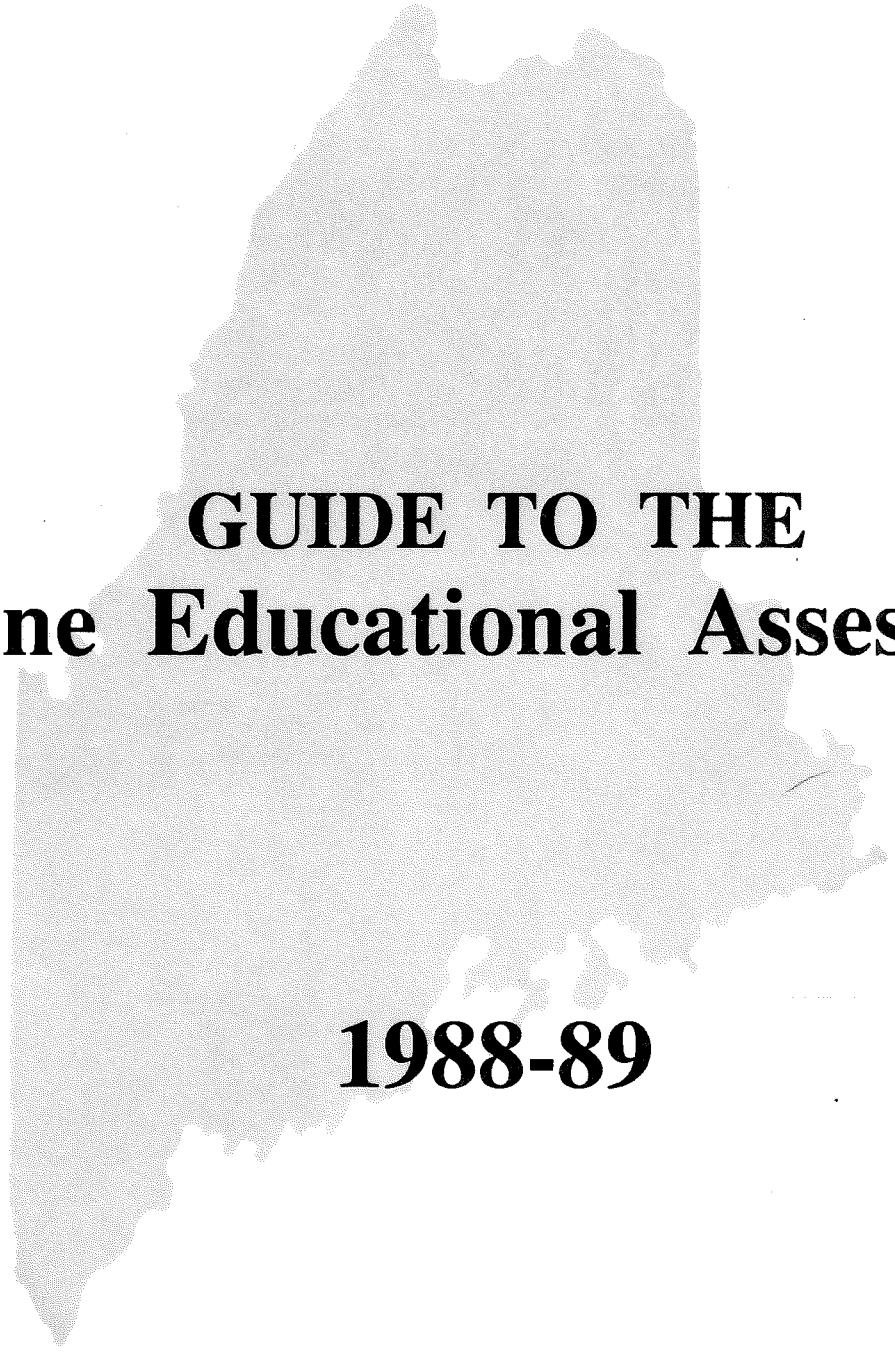

GUIDE TO THE
Maine Educational Assessment

1988-89

Department of Educational and Cultural Services
Division of Educational Assessment

CONTENTS

FOREWORD

During the first three years of the Maine Educational Assessment, we received a great deal of cooperation and support from all levels of the education community. As the policies relating to the program were refined and school teachers and administrators became more familiar with the program, it was most gratifying to see many schools recognize and take advantage of the wealth of information the MEA provided on curriculum and instruction. My staff and I have spent a considerable portion of our time in schools throughout the state and have readily seen that school personnel examine their test results seriously and use them, along with other information, to improve their programs. During the 1988-89 school year, we intend to operate much as we did in 1987-88. However, during the year we will also be investigating possible changes for the years to come – changes involving such things as the use of open-ended questioning in all subjects or the design and administration procedures associated with the writing test. Reactions of teachers and administrators will be our primary source of information in evaluating the various options. We will continue to provide assistance to schools both through large workshops and through the consulting services of the MEA staff. If you have any questions at all about the program or if you wish to request technical assistance in the interpretation and use of test results for instructional/curricular improvement, please call us. I am looking forward to another rewarding and productive year.

Randy Walker

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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 fourth 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 1988-89 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 1988-89 school year are:

Grade 8 – October 24 to November 4, 1988
Grade 4 – January 23 to February 3, 1989
Grade 11 – March 27 to April 7, 1989

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 outlined in the handbook titled *Maine Educational Assessment: Manual on Policies and Procedures for Students Requiring Assessment Modifications.* Exclusions from testing will be minimized and well-documented.

Do Some Schools Exclude More Students than They Should from MEA Testing?

While local school personnel make decisions regarding the exclusion of students from testing, the guidelines for exclusions are very clear. They are stated in the *Manual on Policies and Procedures for Students Requiring Assessment Modifications*, distributed to schools every fall.

The high percentages of students completing the full test battery each year suggest that violations of the exclusion rules are few. The Division of Educational Assessment does examine the number of students excluded in every school and the reasons for the exclusions. Any exclusions that seem unreasonable or illegitimate are investigated.

What Kind of Tests Are Being Used?

The program combines aspects of standardized achievement testing and program assessment. A set of "common questions," administered to all students at a grade in the state, will yield reliable individual student test and subtest scores in reading, writing, and mathematics. The common item set, however, does not provide the broad coverage of content areas and program evaluation capability afforded by the former statewide testing program, the Maine Assessment of Educational Progress (MAEP). Therefore, other questions, called "matrix-sampled" questions, are distributed over many booklets so that each of these questions will be answered by a sample of students. Matrix-sampled questions are used in reading, mathematics, science, social studies, and the humanities. Many different test forms are used at each grade level tested; each contains the common items and a fraction of the matrix sampled questions. The matrix-sampling technique allows for broader assessment of many content areas at the school level using a minimum amount of testing time.

The tests are tailored to objectives frameworks developed by various advisory committees made up of Maine teachers, administrators, and curriculum experts. All areas except writing will be tested with multiple choice questions; writing will be tested directly through writing prompts eliciting samples of students' writing. In addition, students will be administered up to twenty open-ended reading and mathematics questions. These items will assist in measuring higher order thinking skills.

Student, teacher, and principal questionnaires will assess a variety of background, experiential, attitudinal, and instructional variables. The information obtained from these instruments will play an important role in the reporting and interpretation of the assessment results.

How Reliable Can Results Be Since Matrix-Sampled Items May Only Be Answered by a Few Students in a School?

The technique of matrix sampling as used in Maine produces school scores that are more reliable and more valid for purposes of program evaluation than traditional methodologies. Test length is one factor that affects test reliability. Matrix sampling involves the construction of a large number of test questions and distributing them across several nonequivalent test forms so that not every question is answered by every student. Large numbers of questions, however, are answered in any school. Validity is enhanced because of the more complete coverage of the content domains provided by the large number of test items used. Last year, school scores were based on approximately 200 test questions in every subject area except humanities, in that subject approximately 100 questions were used at a grade level.

It is important that anyone trying to understand matrix sampling put aside many of the notions associated with testing programs intended to produce individual student scores. The Maine Educational Assessment involves the sampling of both content (in

terms of the coverage of a subject area) and students (since not every item is answered by every student). The sampling of content is far superior to that provided by other forms of testing, not only because of the number of items, but also because repeated measures of specific skills or concepts are not required as they might be to generate reliable student scores. The sampling of students is also outstanding. While any one student may answer only a limited number of questions in a subject area, a score for that student is not computed as an intermediate step toward the computation of a school score.

School scores are complex aggregations of item results, not student results. With items in a reporting category (i.e., subtest) spread across the different test forms, it is reasonable to expect that most of the students in a school took one or more items in that category. Concerns that a difficult question might have been answered only by a few weak students and similar situations are invalid for two reasons. First, item difficulty is taken into account in the scaling techniques used in going from item results (percents correct) to school scores. Second, aspects of random sampling assure the distribution of items in a reporting category to a wide range of students in a school. In summary, a large number of items in an area are administered in a school, and most students in the school answer questions in any particular reporting category. In producing school scores, this situation is far preferable to having many fewer items administered with all students, instead of most students, answering each item.

A useful parallel to matrix sampling might help one understand the technique better. Suppose you and five friends go into a new restaurant, intending to evaluate its food. Would you all order the same dish? Of course not. Even though individuals have different tastes and experiences, there is enough commonality across individuals that you would most likely be comfortable with each person trying a different dish to get a better sampling of the menu. The menu, in this example, and be compared to a school's curriculum.

Another question raised about the limited number of students taking a matrix-sampled question concerns the limited number of values for item results that could occur. If four students answered a particular question, the possible percents correct could only be 100, 75, 50, 25, or 0. Thus, a school's percent correct on a matrix-sampled item is likely not to be close to what it might be if all students were administered the item. This is not a problem since we are not interested in reporting school-level item results for matrix-sampled items. Those items and the few students who answered them are contributing their bits of information to a much larger pool of information based on many items and students. School scores are the result of piecing all of these bits of information together. Besides, in testing programs producing student results, a single item is either answered correctly or incorrectly by the student — i.e., its contribution to the student's score is either 100 percent or 0 percent.

The Technical Summary for last year's assessment provides more complete information on matrix sampling, test reliability, etc.

Why Don't All Students Respond to the Same Writing Prompt?

In the first two years of the assessment, each student responded to the same two writing prompts, with an hour of testing time allowed for each and considerable time and expense required for analytic scoring. In order to make some improvements in the testing of other subject areas, it was decided to have each student respond to one prompt, with two different prompts administered in every school. This change had little, if any, impact on the quality of school level data in writing, but has raised some concerns about the student level data.

There are some people who are concerned that two writing prompts may be of different levels of difficulty. Prompt "difficulty," in and of itself, is not a problem. While raw scores may be lower for one prompt, the percentile rank that is reported for every student is based on the half of the students across the state responding to the same prompt. Furthermore, an important criterion in selecting a prompt for inclusion in the MEA is that it be on a topic about which any student will have something to say. Thus, all students face the same kinds of challenges in the writing test, even though they write on different prompts.

The prompt can make a difference in the quality of writing it elicits, particularly because there is good evidence that the type of writing (mode of discourse) makes a difference. Thus, the MEA procedures have a degree of unfairness at the individual student level if there are differences among schools in the instructional emphasis given to different modes. For example, an eighth grader who had no instruction in persuasive writing would be at a disadvantage compared to other students if he or she receives a persuasive prompt. For individual students in a school, it would be fairer for all students to take the same prompt — even if it should be the persuasive one. However, thinking in terms of school level results, how fair would it be to use only one persuasive writing prompt across the state? The school that does not teach persuasive writing would be at a distinct disadvantage. This is why the technique of matrix sampling is so important in a program producing school results in any subject area. Ideally, to produce the best school results in writing, a program would administer many more than two types of writing prompts — even if each student takes only one. In the MEA, only two are used at a grade level, but they are generally two very different prompts. Thus, in the MEA, while we can do what is best for both student and school scores in the areas tested by multiple-choice questions (where we use both common and matrix-sampled questions), we have had to make a compromise in writing.

How Will Results Be Reported?

Student Results

Individual student results will be based on the common items and will be reported in two ways. First, students' scores in reading, mathematics, various subdomains of reading and mathematics, and writing will be provided in a form suitable for mailing to parents as well as on gummed labels for inclusion in permanent school files. Second, data summaries reporting each student's response to each common test question will be provided to the schools. These summaries will also show school and state average percents correct for each of these items.

School Results

The School Report will be in the form of a booklet. Results will be laser printed on preprinted formats, and narrative description will aid in interpretation of the data.

The School Report will include:

- the number of students tested, the number of students with handicapping conditions tested, etc.
- an average test score and student score distributions for each of the six content areas, including the areas covered only by matrix-sampled questions. The scores will be scaled scores so that they will be comparable from area to area and from year to year. In fact, the report format will accommodate several years of results so that school personnel can monitor changes in performance over time.
- information on a school's status relative to the district and the state, based on background factors such as parental education and size and type of community. More importantly, this information will be used to produce comparison score bands which will enable school personnel to compare the performance of their students to that of students in comparable schools across the state, rather than all schools statewide.
- scaled scores for the performance of a school in subcategories of each content area. For example, performance will be reported for areas of mathematics such as computation, geometry, and measurement.

Additionally, achievement results for subgroups of students defined by responses to student questionnaire items will be reported. This will help to identify the variables that seem to be more highly correlated with student achievement.

State Reports

Various interpretive summaries of statewide performance in the different curricular areas, highlights brochures, and a technical report will also be produced. Interpretations, conclusions, and recommendations presented in these documents will result from collaborative reviews of the data by curriculum advisory committees, state department staff members, and the contractor for the assessment.

What Kinds of Changes Can One Expect to Find in School Scores from Year to Year?

The variability in performance among Maine schools is relatively small compared to that in many other states. Nevertheless, the use of scaled scores based on Maine norms (as opposed to national norms) appears to spread school scores out. The scale for 1985-86 (base year) school scores had a mean of 250 and a standard deviation of 50. The scores for a particular school accurately represented the performance of students in that school in 1985-86. Because of the variability of achievement levels of classes of students passing through a school and because of the homogeneity of Maine schools, it would not be unusual for a school to experience seemingly large shifts in scores across years (e.g., 40 or 50 points) even without making any changes in curricular/instructional programs. A particular class of students is just one sample from all the classes that pass through the school. For this reason, data from more than one year should be examined for purposes of program evaluation. This year's school reports will show the scores for 1986-87, 1987-88, and 1988-89, and they will also give three-year averages. Enough test items will be reused from year to year so that comparisons can be made over time and different years' tests can be linked statistically. If statewide performance changes, the statewide averages will also change. The 1987-88 statewide averages in many areas, for example, were not 250 as they were in the first year of the program. This is true for all areas except writing.

Can School Personnel Reproduce or Retain Copies of the Test Forms?

DEFINITELY NOT!!! After testing is completed in a school, all test forms must be returned to the assessment contractor along with other testing materials. Any schools that reproduce or retain copies of the test forms may be subject to having their test results declared invalid. Copies of the common items in reading, writing, and mathematics will be returned to the schools with the reports of results; copies of these questions may be reproduced for internal school use. However, the bulk of the test questions administered via matrix sampling must remain secure.

Department policy regarding test security is based on several considerations. First, some of the test questions in the MEA are reproduced with permission of the source agency with the provision that their security be maintained. Second, comparability of results across years is achieved by the use of test questions administered in two consecutive years. Many of the matrix-sampled questions are new each year, but some are not. This comparability allows a school to interpret changes in scores from year to year as reflecting real change regardless of any changes in statewide averages. Given the MEA design to achieve data comparability, the need for test security is obvious.

Along with their testing materials, principals return a signed form certifying that, to the best of their knowledge, procedures outlined in the testing manuals (including policies regarding the security of materials) were followed in their schools. In a few instances when security violations were uncovered, the consequences to the schools and school personnel were severe.

The desire of local school personnel to examine specific test questions is often associated with a specific skill orientation. This may be appropriate at the local level where performance in a district's specific objectives might be the focus of evaluation. The MEA does not measure specific skills so much as performance in broader domains of skills and understandings. While the set of test questions in a reporting category must represent the range of material that the category encompasses, a very specific skill or concept may not be tested every year.

How Does the MEA Fit in with Other Testing Programs Used in a District?

The MEA is not intended to replace any other testing programs. Most other programs provide information on specific skills or on individual students. For example, districts often use locally developed tests (or commercial tests matching local objectives best) to determine how well their students are mastering the specific skills or objectives listed in the scope and sequence of the local curriculum. Other tests are designed to diagnose specific weaknesses of each student. Some commercially produced tests are general achievement measures that report student scores in general categories. These may be useful as one piece of information to use in making placement decisions. All of these types of tests are of use in **internal evaluation**. Even though composite group results may be reported for such tests, quality indicators (e.g., reliability coefficients) pertain to individual scores, not school averages. Furthermore, these tests do not provide the broad coverage of a content area that is desirable in evaluating programs from an external perspective.

A primary purpose of the MEA is the **evaluation of curricular/instructional programs.** Large numbers of test items administered through matrix sampling allow for the reporting of school-level scores in many subdomains within a subject. Statewide norms, produced each year based on that year's actual data, and other statistics appearing in the school reports provide schools with useful information on their position relative to others in the state and others serving similar populations of students. If a relative weakness within a subject area is identified, then information in this guide on test content and local personnel's knowledge of the local program should be examined to determine why. (An area of relative weakness may reflect a conscious decision made in curriculum planning to put off instruction in that area at that grade level until after the time of MEA testing. In such a case, it may be decided to do little about that apparent weakness.)

How Will the MEA Be Different in 1988-89?

There are very few changes in the way the MEA will be conducted in 1988-89. The recommended testing time for the writing portion of the test will be twenty minutes longer than before. Although the MEA tests are not intended to be timed tests, instructions for past years were vague about how much extra time students should be allowed to finish a test. For purposes of standardizing testing conditions, unlimited extra time would be inappropriate. In writing, where additional time could be a larger problem, we are adding to the minimum time. Also, a maximum amount of additional time of not more than 50 percent of the recommended time for any session has been set.

The student questionnaire will be completed after the last testing session, rather than before the testing sessions. It is still most important that every student complete the questionnaire since questionnaire responses are used to define subgroups of students in the school reports.

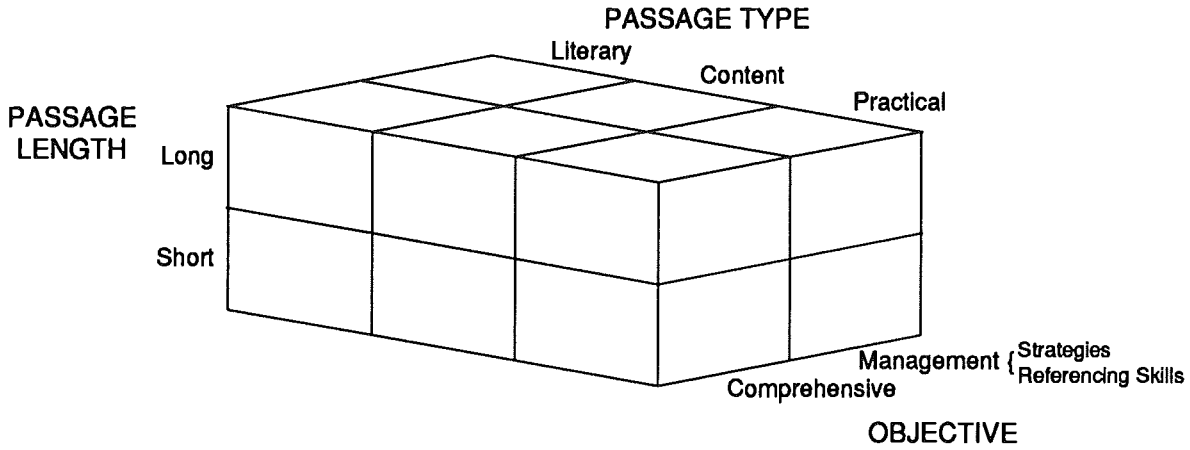
While major changes in the MEA are not being made this year, there are significant ones being considered for the future — some involving open-ended questioning and the writing tests. During this school year, reactions of teachers and administrators to possible changes will be solicited.

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. Finally, brief suggestions for instruction are provided, based on the findings of past MEA tests and advisory committees' interpretations of them. The discussions of instruction in the different subject areas focus on the kinds of thinking addressed by the MEA.

Reading

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



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 reading 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.

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.

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 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.)

Reading Management

The reading 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 on the next page.

QUESTION 4	QUESTION 5	QUESTION 6
(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.	(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.	(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?

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, content, and practical areas. Each passage is introduced by a carefully worded purpose-setting statement, designed to activate relevant prior knowledge and provide a focus for reading.

Instruction Emphasizing the Reading Process

Two aspects of recent views of experts regarding the reading process have important implications for instruction. These aspects are (1) a shift in emphasis from the role of text in the construction of meaning to the active role of the reader, and (2) a deemphasis of specific, isolated reading skills and greater concern for the total reading process.

The Reader's Role — Reading Management. Reading has often been perceived as thinking with text. One of the reasons for the MEA's attention to reading management is the acknowledgment that the reader has a major responsibility for determining how and what to think when reading — i.e., the reader is an active participant in the process, not a passive spectator. While reading, the good reader continually, and sometimes automatically, uses information from the reading material and from his or her own storehouse of knowledge to make decisions about the reading process(es). The poor reader does so less, if at all. Researchers have found that reading performance can be improved considerably by bringing this decision-making to a higher level of consciousness. Thus, teachers should try to teach students to make conscious decisions about how to read, based on information about the type of reading material, the purpose for reading, etc. The area of reading management is actually dealing with the metacognitive aspects of reading since it involves thinking about reading, and, hence, thinking about thinking.

A reader's comprehension of text is greatly influenced by the reader's prior knowledge. It is important that teachers themselves understand the role prior knowledge plays in comprehension and make their students aware of that role as well. There are two kinds of prior knowledge — (1) exposure to and familiarity with differences among types of reading and reading matter (genre, structure, purposes for reading), and (2) informational (content) background from reading or other experiences. It is the job of the teacher to help students "activate" their prior knowledge when reading and to foster its development. The strategies good readers use vary, depending on the type of material and reason for reading it. Thus, teachers of reading should provide their students with a wide variety of reading materials and reading purposes. Attention to many types of literary, content, and practical works, as defined previously, is desirable.

Brainstorming about a topic before assigning a reading task is a fairly common classroom activity — particularly at the elementary levels. Such activities are not simply motivational techniques. More importantly, they activate relevant prior knowledge — something students should be encouraged to do independently in any reading situation and at any grade level. Brainstorming often starts as random idea generation, but can be turned into more focused thinking, tied more closely to a particular passage. Another important prereading activity is predicting the type of information to come later in a passage. (Readers are more successful at determining what is most likely to come if they bring to the reading task a great deal of experience with different genres or types of reading.) Thus, titles, opening sentences or sections, and other aspects of reading materials might be used as clues to answer teacher-posed questions about passages yet to be read. For example, a reader

of a newspaper article on some community issue might well be expected to anticipate arguments on two sides of the issue. This expectation should alert the reader to the need to evaluate arguments as they are presented and then formulate an opinion based on the evidence. Again, it is important that teachers strive to make students practice this "thinking about what is to come" on their own.

Previous MEA results suggest that many students are not aware of different strategies to apply to different reading tasks. Direct instruction in reading strategies and extensive practice identifying appropriate strategies for many different kinds of reading would be worthwhile components of a reading program. (It is important, however, that strategies be taught in conjunction with real text and not in isolation.) Similarly, many students appear to be unfamiliar with self-checking strategies — strategies to detect and remediate their own comprehension problems. Many students did not know why the author of a passage from a social studies text asked a particular question in the middle of the section — a question the author obviously intended the reader to answer to assist or confirm comprehension before reading further. How many readers stop appropriately in the middle of text to ask themselves such questions? These strategies should be taught and tested and their use encouraged in noninstructional situations. Whether the concern is the activation of prior knowledge or the selection and use of different reading strategies, instruction should follow the logical sequence of demonstration (teacher modeling), guided practice, and independent practice with sustained feedback — keeping in mind that the goal is to get students to apply the "model" techniques on their own when they read.

Comprehension-Enhancing Materials and Methods. In addition to giving attention to reading management, the teacher has other responsibilities associated with developing students' reading comprehension. The importance of providing students with a variety of types of reading materials has already been discussed in conjunction with prior knowledge. It is also important that the reading matter consist of rich, whole texts. Short, contrived, incomplete passages typical of many traditional reading tests do not represent the kinds of text students would encounter in non-testing contexts and do not foster the kinds of reading management behaviors students need. Nor do they generate the kinds of questions most desirable for teachers to ask of students and for students to ask of themselves to evaluate and improve comprehension. Carefully constructed questioning should involve:

- attention to essential ideas — Asking a question because a particular skill question is required, even if the question addresses an unimportant idea, cannot help students develop the ability to identify the essential ideas in a piece.
- attention to different levels of inference — It is the higher levels of inference that lead to the greater enjoyment of literary pieces, the deeper understanding one should gain from content pieces, and the utility of practical pieces.
- sustained feedback to help students improve their answers.

Finally, the joining of instruction in reading and writing has been shown to promote growth in both reading comprehension and writing performance. The common behaviors used by successful readers and writers are numerous (e.g., prereading and prewriting activities, the way in which both meaning from text and written matter evolve, the monitoring of performance). More will be said about the "reading/writing connection" in the next section on writing.

Writing

The MEA assesses writing skills directly through the use of writing prompts eliciting samples of students' writing. The objectives addressed by the writing component of the MEA program were developed by the writing advisory committee and are listed below:

Objective I — Comprehends and Manages the Writing Experience

- The writer will demonstrate the ability to generate a piece of writing and apply strategies that help him/her to produce and refine that writing.
- The writer will demonstrate the ability to organize and present information so that the writing fulfills its purpose and makes sense to its intended audience.

Objective II — Makes an Individual Response

- The writer's voice is evident, and the writing demonstrates the writer's interest and involvement in the piece.

Objective III — Conforms to Conventions

- The writer will aid others in reading his/her writing by using the conventions of standard edited American English: punctuation, usage, spelling, legibility, format, paragraphing, margins.

The MEA tests address these objectives in three ways — through the choice of prompts administered to the students, through the procedures by which they are administered, and through the way in which the writing samples are scored.

Prompts

Each student responds to one of the two prompts selected for each grade level. Each prompt clearly states a purpose and an audience, and some prompts call for prewriting activities. Generally, writing prompts have been categorized according to traditional modes of discourse:

- narration - tell a story or narrate an event;
- description - evoke a sense experience;
- exposition - inform, instruct, present ideas;
- argument - convince, persuade, demand, refute.

While labels have been attached to the MEA prompts, this has been done with the full recognition that prompts do not always fall cleanly into one and only one category. It is often appropriate for responses to a prompt to contain elements of different modes. The two prompts used at a particular grade level are intended to elicit different types of writing because of the desirability of different measures for purposes of program-level evaluation. (See page 4.)

Three other criteria for the selection of writing prompts are that they be interesting to students, that they be on topics about which any student would have something to say, and that they elicit enough text from students to be effectively scored. Field testing of the prompts provides useful information on these criteria. The prompts that have been used in the MEA are not secure and have been included in the materials sent to the schools with test results.

Test Administration

Students are allowed up to 90 minutes to produce their writing samples. They may prepare a draft and edit it before transferring it to the booklet that is ultimately scored. Reference aids such as dictionaries and thesauruses are available to the students.

Scoring

Writing samples are scored by Maine teachers and administrators at 3-day sessions. Each composition is scored independently by two readers for six attributes:

Topic Development: measures the overall effect and the fluency of the paper; reveals the ability to write in the appropriate mode of discourse; shows awareness of the audience and the purpose for writing.

Organization: measures the degree to which the response is focused and clearly and logically ordered.

Details: evaluates the use of appropriate reasons, details, and examples to enhance the effect and/or support the conclusions of the piece.

Sentences: examines the degree to which the response includes sentences that are (1) complete and correct; (2) varied in structure and length.

Wording: evaluates the student's choice of words for correct usage, specific vocabulary, freshness and vividness of language.

Mechanics: measures the correct and effective use of spelling, punctuation, capitalization and paragraphing appropriate to the grade level.

Each of these attributes is scored on a scale from 1 to 6. Differences greater than one in the corresponding ratings of the two scorers are adjudicated by the table leader.

Instruction Emphasizing the Writing Process

There are some basic characteristics of what has been called the "process model" approach to writing instruction. They include student choice of writing topics, giving students a stronger sense of ownership in their writing; prewriting activities (group and individual) such as brainstorming; the writing of multiple drafts, making changes in both grammar and meaning; conferencing through which teachers provide feedback to writers on their drafts; and sharing of papers with other students, again for feedback as well as for idea generation. In schools where these characteristics occur more often, MEA school scores in writing tend to be higher. Thus, a recommendation based on MEA results is that writing programs incorporate these characteristics into instruction.

It is important that students write frequently in a variety of modes, on a variety of topics within each mode, in both real-life and school situations, in all content areas, and for a variety of purposes and audiences. Characteristics of good writing vary, depending on the audience and the purpose for writing. To develop the ability to write effectively, students need experience with a variety of situations.

The discussion on writing seems to echo that in the previous section on reading. A piece of writing evolves through drafts based on additional information, just as comprehension evolves based on information obtained through further reading. Furthermore, the writer must accept a great deal of responsibility for managing the writing process. An effective writer approaches writing tasks differently, depending on the purpose for writing; an effective reader's strategy also varies, depending on the purpose for reading. Writing can be considered thinking as much as reading can, and much research has focused on the reading-writing connection. Reading, evaluating, and discussing the writing of others (published and not) from a writing perspective can certainly benefit writing instruction. In some schools, students have been trained much like MEA scorers and then asked to use the MEA scoring system to evaluate student writing.

Mathematics

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

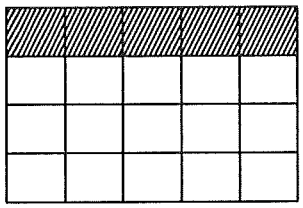
PROCESS	CONTENT: Numbers and Numeration	Variables and Relationships	Geometry	Measurement	Problem-solving Skills	Other Topics
Conceptual/Knowledge						
Procedural						
Problem Solving						

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. The four questions below are examples of questions that would be categorized "conceptual/knowledge."

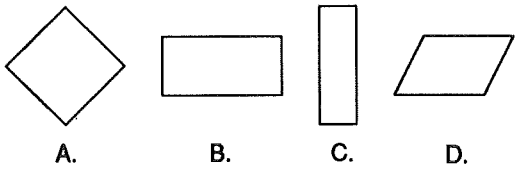
What fractional part of the large rectangle below is shaded?

E. $\frac{5}{15}$
F. $\frac{15}{5}$
G. $\frac{1}{4}$
H. $\frac{3}{4}$



CONTENT: Numbers and Numeration
PROCESS: Conceptual/Knowledge

Which figure is NOT a rectangle?



CONTENT: Geometry
PROCESS: Conceptual/Knowledge

The average of two different numbers is
A. smaller than either.
B. greater than either.
C. halfway between them.
D. between them, but not always halfway.

CONTENT: Other Topics
PROCESS: Conceptual/Knowledge

How many ounces are in one pound?
E. 12
F. 16
G. 24
H. 32

CONTENT: Measurement
PROCESS: Conceptual/Knowledge

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.

Subtract:
$$\begin{array}{r} 86{,}463 \\ -\ 3{,}795 \\ \hline \end{array}$$

A. 82,668
B. 83,332
C. 83,668
D. 83,778

CONTENT: Numbers and Numeration
PROCESS: Procedural

$$\begin{array}{r} 35 \\ \times\ 3 \\ \hline \end{array}$$

Andrew multiplied the numbers above. Which statement below is true?

A. Andrew does not understand place value.
B. Andrew does not know his multiplication facts.
C. Andrew's answer is correct.

CONTENT: Numbers and Numeration
PROCESS: Procedural

$2x - 5 = 31$. What is x?

A. 36
B. 26
C. 18
D. 13

CONTENT: Variables and Relationships
PROCESS: Procedural

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. Sample test questions are shown below.

A cab driver makes $0.22 per mile when passengers are in the car. If the driver travels 403.5 miles, 34 of which are without passengers, how much does he make?

A. $16.79
B. $81.29
C. $88.77
D. $812.90

CONTENT: Numbers and Numeration
PROCESS: Problem Solving

There are 4 people in a room. If each person shakes hands once with each other person, how many handshakes take place?

A. 4
B. 6
C. 12
D. 16

CONTENT: Other Topics
PROCESS: Problem Solving

A van can hold 8 passengers. There are 42 fourth graders in Woodward School. How many vans would be needed to take 25 of the fourth graders to the museum?

What information in the above problem is NOT needed to solve the problem?

A. There are 42 fourth graders in the school.
B. A van can hold 8 passengers.
C. Twenty-five fourth graders are going to the museum.
D. All of the given information is needed.

CONTENT: Problem-Solving Skills
PROCESS: Problem Solving

Andre told Jane that he had 5 coins in his pocket worth 75 cents. None of the coins were pennies. To find out what the coins were, Jane started by thinking about quarters.

First she supposed there were 3 quarters. That meant two more coins of any kind would raise the value over 75 cents.

Then she supposed there were 2 quarters.

What should Jane do next?

A. Suppose there is only one quarter.
B. Find the combinations of dimes and nickels totalling 25 cents.
C. Suppose there are no quarters.
D. Find the combinations of dimes and nickels totalling 50 cents.

CONTENT: Problem-Solving Skills
PROCESS: Problem Solving

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.

Concepts, Topics, and Skills

Grade 4

NUMBERS AND NUMERATION

Numeration
- –translate numerals into words
- –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
- –recognition of =, <, > signs
- –expanded notation

Number Theory
- –completing number sequences
- –even and odd numbers
- –common multiples (e.g., counting by 3's and 5's)
- –set membership given diagrams

Grade 8

NUMBERS AND NUMERATION

Numeration
- –order fractions
- –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

Grade 11

NUMBERS AND NUMERATION

Numeration
- –order fractions and decimals
- –round to nearest hundred
- –round to nearest hundredth
- –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
- –number patterns
- –even and odd numbers

Grade 4	Grade 8	Grade 11
Operations - Whole Numbers –addition of 5-digit numbers –subtraction of 5-digit numbers –multiplication of 2-digit numbers –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 & subtraction –non-routine word problems involving addition and/or subtraction	**Operations - Whole Numbers** –exponents –add and subtract large numbers –multiply 3-digit numbers by 2-digit numbers –order of operations –simplify expressions with grouping symbols –routine word problems (1-step & 2-step, all operations) –non-routine word problems	**Operations - Whole Numbers** –exponents –square roots (concept of) –add and subtract large numbers –multiply 2-digit numbers by 3-digit numbers –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 –addition of simple fractions with like denominators using pictorial aids	**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 number –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 –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 money	**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)

Grade 4	Grade 8	Grade 11
	VARIABLES AND RELATIONS **Equations/Inequalities** –find missing addends –solve simple algebraic equations –simple substitution questions –translate word problems into equations –solve simple problems that lend themselves to writing equations **Functions/Coordinate Systems** –find the coordinates of a point –understand transitive property –determine rules/patterns (equations)	**VARIABLES AND RELATIONS** **Equations/Inequalities** –simplify algebraic expressions –sustitution problems –translate word problems into 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)
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 circle –estimate the size of an angle –recognize congruent figures –use proportionality of similar triangles to find lengths –select correct construction –recognize line of symmetry **Properties of Triangles** –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 circle –estimate the size of an angle –recognize congruent figures –use proportionality of similar triangles to find lengths –select correct construction –recognize line of symmetry **Properties of Triangles** –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 inch –read ruler to nearest centimeter	**MEASUREMENT** **Using Instruments** –read protractors –read clocks –determine elapsed time	**MEASUREMENT** **Using Instruments** –read protractors –determine elapsed time –read thermometers

Grade 4	Grade 8	Grade 11
–estimate length in centimeters –read clocks –read thermometers –estimate distance on map using a key –read scale	–read thermometers –read rulers to the nearest quarter inch	–read rulers to the nearest quarter inch
Unit Equivalents –relationship between measurment 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 –summarize problems –select the question that has the same answer as another word problem	**Understanding the Problem** –summarize problems –select the question that has the same answer as another word problem	**Understanding the Problem** –summarize problems –select the question that has the same answer as another word problem
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 and Processes** –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 and Processes** –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 diagrm one might use to solve a problem
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

Grade 4	Grade 8	Grade 11
OTHER TOPICS	**OTHER TOPICS**	**OTHER TOPICS**
Probability	**Probability and Statistics**	**Probability and Statistics**
–spinner problems with probability related to areas of regions	–spinner problems with probability related to areas of regions	–spinner problems with probability related to areas of regions
–simple combinations	–determine probability of spinning a given number	–determine probability of spinning a given number
	–compute simple combinations and permutations	–compute simple combinations and permutations
	–compute the average of 5 numbers	–compute the average of 5 numbers
	–demonstrate understanding of average as a measure of central tendency	–demonstrate understanding of average as a measure of central tendency
	–find median	
Graphs, Tables, and Charts	**Graphs, Tables, Charts**	**Graphs, Tables, Charts**
–read and use calendars	–read line, bar, circle graphs and charts	–read line, bar, circle graphs and charts (i.e., locate data)
–read charts	–determine output of flow chart	–determine output of flow chart
–interpret charts (e.g., most, fewest, etc.)	–interpret line, bar, circle graphs and charts (i.e., draw conclusions)	–interpret line, bar, circle graphs and charts (i.e., draw conclusions)
–read pictographs using a key	–select the appropriate graph for data given in tabular form	–select the appropriate graph for data given in tabular form
–read line graphs		
–interpret line graphs (e.g., most, fewest, etc.)		
–draw conclusions from graphs		
–read and interpret bar graphs		

Instruction for Thinking in Mathematics

The Maine teachers on the mathematics advisory committee have been concerned that many students at all grade levels seem to regard mathematics as a collection of procedures to be followed "mechanically" without requiring thought. This inference is well-supported by MEA test results. For example, many students

- apply an erroneous algorithm to perform computations they should readily perform in their heads (e.g., when asked to add 1/2 + 1/4 , given a diagram of a circle divided into a "1/2" sector and two "1/4" sectors, many students answer "2/6");
- do not evaluate the reasonableness of answers to either computations or word problems;
- do not apply appropriate strategies to solve word problems (e.g., do one-step computations with the numbers appearing in a word problem regardless of what the problem actually requires for solution; feel that writing an equation is always appropriate and are not aware when pictures or tables would be helpful).

Mathematics instruction should dispel this apparently widespread belief that doing math does not require thought.

Comprehension. Unfortunately, it is easiest to bring about immediate gains in computational skills by minimizing the thinking required — having students memorize the steps of an algorithm and apply them again and again through drill. But memories fail over time, leaving many students lacking in skills that are given a great deal of instructional emphasis year after year. The example above (1/2 + 1/4) is one that students being introduced to fractions should solve using models (paper folding, felt board, picture drawing) long before computational algorithms are ever taught. Furthermore, when far more complex problems are posed that do require the algorithm, students whose memories have lapsed should recognize the appropriateness of examining simpler cases to help them figure out the algorithm. Finally, examining reasonableness of answers, even answers to computations, should be practiced. Two sixths is less than 3/6 or 1/2, and is, therefore, an unreasonable result when the question calls for adding something to 1/2.

As suggested above, frequent practice of mental arithmetic can be invaluable in teaching mathematical concepts and improving mathematical skills. Through mental computing, students must apply the properties of numbers and operations, thereby improving their understanding of them rather than forgetting them as they may do when they can reach answers by following algorithms without thinking. Another activity often neglected in math classes is having students answer "why" questions. Students demonstrate understanding of mathematical concepts by translating or explaining them, yet they are seldom asked to write explanations in words.

Something else for teachers to consider is the mismatch of student and teacher goals associated with both in-school and homework assignments. A teacher assigns schoolwork hoping that the practice will improve students' comprehension. A student's goal is often to get the twenty problems done — understanding is not a concern. Teachers should try ways of changing this common "production" goal of students to a "comprehension" goal. For example, perhaps each student could determine how many problems should be completed to be satisfied that he or she understands the material. This might require students

to take greater responsibility for their own learning. Although students may have difficulty with this at first, follow-up, checking/testing activities could soon change this.

Problem Solving. Mathematical skills are not important skills in and of themselves. Their value lies in their use for solving problems. The ultimate goal of mathematics curriculum and instruction must be to produce better problem solvers — therefore, problem solving should be the major focus of mathematics programs. Years of assessment data have shown convincingly that giving students the skills does not guarantee problem-solving proficiency. Explicit attention in the classroom must be given to estimating answers to problems, assessing reasonableness, evaluating the relevance of information given in problems, and selecting efficient problem-solving strategies. The mathematics education literature can be most useful to teachers looking for ways to improve problem-solving instruction. Ideas frequently discussed include modeling techniques, student generation of problems, credit for approaches, importance of showing or trying different approaches for the same problems, etc. Again, it is important that teachers and students work toward a common goal — problem-solving proficiency, not simply skill mastery of problem completion.

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
- –experimental design/control (how to improve a study
- –best way to study (empirical/non-empirical alternatives)
- –recognize relevant variables (information needed)
- –best step or sequence of steps to investigate a problem
- –sampling
- –perceptions of scientists and science
- –capabilities of technology
- –responsibility regarding harmful side effects

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

Interpreting/Translating Data
- –read bar graphs
- –read line graphs
- –read circle graphs
- –read tables
- –interpolation/extrapolation
- –draw conclusions from data in graphs and tables

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

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

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
- –identify relevant and irrelevant variables
- –concept of sampling
- –hypothesis vs. fact
- –effects of science and technology on society

Observing and Measuring
- –classifying and sequencing
- –observation vs. interpretation
- –measurement error
- –appropriate measurement units
- –reading instruments
- –appropriate graph
- –scientific notation
- –methods of simplifying and summarizing data

Analyzing and Interpreting Data
- –read bar graphs
- –detecting patterns/relationships in data
- –appropriate generalizations and conclusions from graphs and tables
- –deductive logic
- –assumptions and arguments

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 diseases, disease prevention, AIDS
- –organ systems (respiratory, digestive, circulatory, reproductive)
- –animal behavior (e.g., territoriality, instinct, hibernation, migration, etc.)
- –plant structure and function

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
- –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
- –classifying and sequencing
- –observation vs. interpretation
- –measurement error
- –appropriate measurement units
- –reading instruments
- –scientific notation
- –methods of simplifying and summarizing data

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
- –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 diseases, disease prevention, AIDS
- –organ systems (respiratory, digestive, circulatory, reproductive, nervous)
- –animal behavior (e.g., territoriality, instinct, hibernation, migration, etc.)

Grade 4	Grade 8	Grade 11
–functions of plant parts –commercial uses of plants (e.g., cloth) –phototropism –requirements and products of photosynthesis	–photosynthesis –microorganisms	–plant structure and function –photosynthesis –microorganisms
Ecology and Environment –decay –relationships between plants and insects –relationships between plants and animals –predator/prey relationships –food chains/webs –ecological balance and ecosystems –pollution (causes and effects) –habitats	**Ecology and Environment** –decay –predator/prey relationships –food chains and webs –ecosystems and ecological balance –energy cycle –greenhouse effect –energy in successive levels of food chain –stability of populations	**Ecology and Environment** –decay –predator/prey relationships –food chains and webs –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 –methods of collecting data on distant stars –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	**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.)

Grade 4	Grade 8	Grade 11
PHYSICAL SCIENCE	**PHYSICAL SCIENCE**	**PHYSICAL SCIENCE**
Force and Motion	**Force and Motion**	**Force and Motion**
–simple machines	–simple machines	–simple machines
–simple applications of Newton's laws	–applications of Newton's laws	–applications of Newton's laws
–acceleration due to gravity/falling objects	–acceleration due to gravity (falling objects)	–acceleration due to gravity (falling objects)
–relative motion	–friction	–friction
–gravity	–pendula	–pendula
	–work/force/energy	–work/force/energy
Energy	**Energy**	**Energy**
–electrical safety	–simple electrical circuits	–electrical circuits
–simple electrical circuits	–heat transfer	–heat transfer
–energy use/conservation	–energy transformations	–energy transformation
–forms of energy	–conservation of energy	–conservation of energy
–heat transfer	–characteristics of waves	–characteristics of waves
–reflecting/absorbing light	–reflecting/absorbing light	–reflecting/absorbing light
–shadows	–light refraction	–light refraction
–light refraction	–light reflection	–light reflection
–light reflection	–magnetism	–magnetism
–sound energy	–nuclear energy	–nuclear energy
–magnetism		
Matter	**Matter**	**Matter**
–physical and chemical changes	–physical/chemical changes	–physical/chemical changes
–characteristics of metals	–combustion reactions	–combustion reactions
–atoms	–acids and bases	–atomic structure
–conservation of matter	–atomic structure	–elements, compounds, mixtures, solutions
–states of matter	–elements, compounds, mixtures, solutions	–density
–applications of gas laws (e.g., hot air balloon)	–density	–conservation of matter
–density of salt water vs. fresh water	–conservation of matter	–states of matter/kinetic theory
–evaporation/condensation	–states of matter	–applications of gas laws
	–applications of gas laws	–specific heat
		–periodicity of elements/periodic chart
		–half-life
		–chemical equations

Instruction for Thinking in Science

The Maine teachers on the science advisory committee to the MEA often express dissatisfaction with the higher order thinking skills of Maine students. There is good reason for their concerns. However, this does not necessarily mean that lower order skills are sufficient or acceptable. Students can recall some facts, and cannot recall others.

It is not unusual, on occasion, to hear that "students do not have sufficient background in basic facts in an area to get beyond the lower levels of understanding." Unfortunately, such a statement can be taken as a suggestion that students must memorize many facts before they can be presented with higher order tasks. Such a basis for an instructional program can produce some satisfying immediate results, but can cause more harm than good in the long run. One assessment finding in science prompting the concerns for higher order thinking skills is data showing that even when students do have the "prerequisite" knowledge, they cannot recognize situations in which their knowledge applies.

Science is not a body of discrete, isolated facts. Natural phenomena, the focus of scientific inquiry, can be explained as complex interactions of concepts and principles from across the many scientific disciplines. Similarly, facts are not stored in the human mind as discrete and isolated bits of information. They fit larger structures and, in fact, are retrievable only because of their linkages to other ideas. Thus, the presentation of scientific facts in isolation is inconsistent with the way we remember things. It is important that specific facts and broader concepts, low-level cognitive processes and higher skills all be attended to simultaneously in instruction. This will enhance retention of facts as well as children's higher order thinking.

The implication the MEA advisors have drawn from this discussion and from the review of science results is that students need considerably more exposure to and first-hand experience with major scientific concepts. There are several ways that this can be accomplished. Lessons on a major concept should, in some way, attend to a variety of (1) ways by which the concept can be explained or represented, (2) contexts in which the concept applies, and (3) other concepts which interact with the concept in question to affect or explain natural phenomena. Consider the concept of conservation of matter. Most students would know that "matter can be neither created nor destroyed." The statement of the law is clear and understandable to students. Yet, test results show that many students fail to recognize situations in which the law applies — e.g., dissolving

something in a liquid, changing the physical state of a material. Weighing materials before dissolving, freezing, etc. are activities students could easily do to solidify their understanding. (There are other concepts involved in these examples as well — states of matter, nature of solutions compared to other types of matter, even density.)

The applications of the law of conservation of matter mentioned above are fairly specific. It is important in making major principles more memorable to emphasize their relevance to real-life problems or issues. For example, conservation of energy must play an important role in any discussion of the efficiency of engines and associated heat "loss" and its relevance to safety issues. In most school subjects, educators have often sought "unifying themes" to bring ideas together. Some have even proposed science curricula organized by social problems or issues. A lot of science can be taught in conjunction with environmental issues, energy issues, etc.

Continuing the "variety-in-instruction theme," MEA findings relating the use of different instructional techniques to performance have repeatedly supported the contention that an eclectic approach to instruction is most effective. Such an approach calls for the use of a variety of techniques (demonstrations, hands-on labs, A-V materials, computers, etc.), each in moderation.

The nature of laboratory activities is a particular concern of the MEA science advisors. They feel it is essential that students be heavily involved in complete science investigations from beginning (problem determination, design of investigation, etc.) to end (interpretation of results). Students should collect real data of sufficient quality and quantity to lead to valid conclusions, and they should decide upon and execute the data collection and manipulation techniques to be used. "Cookbook" laboratory activities should be avoided. Finally, teachers should take advantage of the large number of important science concepts that are encountered in even the simplest of investigations (e.g., reasons for selecting plastic rather than metal containers or for measuring the temperatures of different containers of liquids at the same depth, etc.).

Social Studies

The major reporting categories for the social studies portion of the MEA tests are shown in the content-by-process matrix below.

CONTENT

PROCESS	Physical Environment	History	Political Science	Economics	Sociology/ Anthropology	Process Skills
Knowledge/ Comprehension						
Higher Order						

The row and column headings in the matrix above represent 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 social studies content categories better for each grade level. School scores will also be produced for one other category — "Maine Studies," a set of questions assigned to other content categories, but which pertain specifically to the state of Maine.

The cognitive process categories in social studies are the same as those used in science. They are used to assure that the full range of processes is represented in all of the content areas. **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. Also, there is a content category, "Process Skills," that addresses the critical thinking skills of analyzing and evaluating information. Questions testing these skills require minimal content knowledge of social studies content.

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

The major reason England wanted to control other parts of the world in the 18th and 19th centuries was

A. England wanted places where "undesirables" could be sent.
B. England depended on the outside world for many raw materials.
C. the Church of England taught that it was England's destiny.
D. colonies provided an outlet for the relief of overpopulation in England.

CONTENT: History
PROCESS: Comprehension

Under the United States Constitution, the power to tax belongs to the

A. President.
B. Department of the Treasury.
C. Supreme Court.
D. Congress.

CONTENT: Political Science
PROCESS: Knowledge

What is MOST LIKELY to happen when an item which many people want to purchase becomes scarce?

A. People lose their desire for the item.
B. People stop using money and begin using coupons.
C. People have to pay higher prices to purchase the item.
D. People form consumer groups to make sure the item is distributed fairly.

CONTENT: Economics
PROCESS: Higher Order (Application)

The teacher found a Larry Bird T-shirt and asked the class, "Does this belong to any of the boys in this class? The teacher must believe that

A. the T-shirt would not fit any of the girls.
B. only boys would own a Larry Bird T-shirt.
C. boys are better athletes than girls.
D. girls do not misplace things.

CONTENT: Process Skills (Analyzing Information)
PROCESS: Higher Order (Analysis)

Which of the following BEST reflects the views Native Americans held toward the land?

A. They encouraged private ownership of the land.
B. Their views were similar to those of the American colonists.
C. They encouraged public ownership of the land.
D. They felt that the land was to be used but not owned.

CONTENT: Anthropology
PROCESS: Knowledge

[PASSAGE PROVIDED]

What is the strongest evidence in the story that it took place many years ago?

A. The radio was called a "new invention."
B. The teacher wore a heavy woolen overcoat.
C. The travelers were tired.
D. The church steeple needed painting.

CONTENT: Process Skills (Evaluating Information)
PROCESS: Higher Order (Analysis)

Concepts, Topics and Skills

Grade 4

PHYSICAL ENVIRONMENT

Physical Geography
- –place geography (Maine)
- –place geography (United States)
- –place geography (world)
- –surface features (e.g., land forms and regions, bodies of water)

Cultural Geography
- –natural resources (define and identify)
- –natural resources (Maine)
- –agricultural products (Maine)
- –climate regions (U.S./world)
- –population clustering
- –man's use of/adaption to land
- –man's protection of environment
- –characteristics of urban/rural areas

HISTORY

People, Places, Events
- –early settlement of U.S.
- –colonial figures
- –identify presidents
- –identify famous figures of 19th & 20th century
- –sequence of major historical events

Historical Concepts
- –forms of communication
- –forms of transportation
- –early North American inhabitants
- –reasons for European exploration
- –reasons for European settlement of New World
- –Native American/settler relations
- –colonial life
- –origins of holidays

Grade 8

PHYSICAL ENVIRONMENT

Physical Geography
- –place geography (U.S. and world)
- –surface features (e.g., mountain ranges, bodies of water)
- –characteristics of land regions
- –vegetation associated with climate regions

Cultural Geography
- –natural resources (Maine)
- –land regions (world)
- –population density
- –population clustering
- –man's use of/adaption to land
- –man's protection of environment
- –interdependence within ecosystems

HISTORY

Pre-19th Century World History
- –early civilizations
- –early North American inhabitants
- –origins of world religions
- –characteristics/influences of early civilizations (Greece/Rome)
- –life in the Middle Ages
- –characteristics of the Renaissance Period
- –early exploration

19th and 20th Century World History
- –England's Industrial Revolution
- –causes/consequences of WWI and WWII
- –Cold War relations
- –growth of third world nations
- –20th century world figures

Grade 11

PHYSICAL ENVIRONMENT

Physical Geography
- –place geography (Maine)
- –place geography (U.S.)
- –place geography (world)
- –climate regions (e.g., desert, tundra)
- –natural resources of regions
- –agricultural products of regions

Cultural Geography
- –population density
- –population clustering
- –man's use of/adaption to land
- –man's protection of environment
- –influence of geography on politics, economics, settlement and growth, cultural development

HISTORY

Pre-19th Century World History
- –early civilizations
- –origins of world religions
- –characteristics/influences of early civilizations (Greece/Rome)
- –effects of the Crusades
- –life in the Middle Ages
- –characteristics of the Renaissance Period
- –early exploration

19th and 20th Century World History
- –England's Industrial Revolution
- –Age of Imperialism
- –rise of nationalism
- –causes/consequences of WWI, WWII and Korean War
- –growth of third world nations
- –Cold War relations
- –20th century world figures
- –current Middle Eastern events
- –growth of Communism

Grade 4	Grade 8	Grade 11
	Pre-20th Century U.S. History –early settlement –characteristics of colonial life –American Revolution (causes) –U.S. Constitution –industrial growth –Civil War (causes and results) –westward expansion/settlement	**Pre-20th Century U.S. History** –early settlement –American Revolution –birth of the nation –War of 1812 –Jacksonian democracy –Monroe Doctrine –westward expansion/settlement –slavery issues –Civil War (causes and results)
	20th Century U.S. History –social reform (e.g., suffrage and labor movements) –rise of U.S. as world power –U.S. involvement in WWI and WWII –Depression –Cold War –Vietnam War –civil rights movement –U.S. foreign relations	**20th Century U.S. History** –social reform (e.g., suffrage and labor movements) –Spanish-American War –Depression Era –U.S. involvement in WWI and WWII –Cold War –civil rights movement –contributions of political figures (Maine and U.S.) –highlights of distinctive presidencies –Vietnam War –recent international affairs (e.g., Iran-gate)
POLITICAL SCIENCE **Characteristics of Government** –roles/responsibilities of political offices –election processes (e.g., voting) –levels of government (local, state, national) –characteristics of government(s) –political boundaries (e.g., town, nation) –political processes (e.g., role of court) –purpose of U.S. Constitution	**POLITICAL SCIENCE** **Characteristics of Government** –systems of government –United Nations –structure of U.S. government –roles/responsibilities of levels and branches of U.S. government –system of checks and balances	**POLITICAL SCIENCE** **Characteristics of Government** –systems of government –United Nations –principles of U.S. government/U.S. Constitution –roles/responsibilities of levels and branches of U.S. government
Citizenship/Political Processes –capital cities (Maine and U.S.) –reason for rules/laws –individual, legal rights –political symbols –current leaders (Maine and U.S.) –identification of public vs. private institutions –democratic principles	**Citizenship/Political Processes** –creating and implementing laws –electoral processes –individual, legal rights –function of political parties –reason for/interpretations of laws –current government figures (Maine, U.S., world)	**Citizenship/Political Processes** –creating and implementing laws –electoral process –system of checks and balances –individual rights/Constitutional Amendments –political lobbying –reasons for/interpretation of laws –current government figures (Maine, U.S. and world)
ECONOMICS **Concepts and Principles** –definitions of terms (e.g., profit, trade, tax) –marketing practices (e.g., sales, pricing) –purpose of taxes –supply and demand –functions of institutions (e.g., banks) –major industries (Maine, U.S., world) –products vs. services	**ECONOMICS** **Concepts and Principles** –economic terminology (e.g., interest, tariff, export) –production methods –supply and demand –taxation –labor unions	**ECONOMICS** **Concepts and Principles** –supply and demand –production/marketing practices –taxation –labor unions –changes in U.S. agricultural economy –Maine state economy –international trade (tariffs, dollar value)
Personal Economics –wants vs. needs –ways of earning money –ways of managing money	**Characteristics of Economic Systems** –characteristics of economic systems (e.g., capitalism) –stock market –personal economics/budgeting –Common Market	**Characteristics of Economic Systems** –characteristics of systems –stock market –recent international economic events

Grade 4	Grade 8	Grade 11
–employer/employee relations –consumer practices and protection		–Common Market
SOCIOLOGY/ANTHROPOLOGY	**SOCIOLOGY/ANTHROPOLOGY**	**SOCIOLOGY/ANTHROPOLOGY**
Family and Community –social institutions (e.g., family, education) –similarities/differences among institutions –primary family members –social behavior/interaction –changing roles of men and women –cultural transmission –social mobility	**Social Issues** –social behavior/interaction –changing roles of men and women –changes in social institutions (e.g., family life) –characteristics of urban/rural life (e.g., crime rate, unemployment) –contemporary social issues (e.g., urban renewal, bilingual education) –effects of technology on society –global social issues (consequences of war) –peer pressure	**Social Issues** –social behavior/interaction –changing roles of men and women –changes in social institutions (family life) –characteristics of urban/rural life (e.g., crime rate, unemployment) –contemporary social issues (e.g., urban renewal, bilingual education) –cultural stereotypes –effects of technology on society –global social issues (consequences of war)
Cultural Studies –cultural universals/basic needs –cultural traits/values –cultural groups (e.g., Native Americans) –similarities/differences among cultures –contributions of various cultures to American culture	**Cultural Studies** –cultural universals –cultural traits/values –cultural transmission –similarities and differences among peoples –cultural stereotypes	**Cultural Studies** –cultural universals –cultural traits/values –cultural transmission –similarities and differences among peoples –ethnic group immigration and settlement
PROCESS SKILLS	**PROCESS SKILLS**	**PROCESS SKILLS**
Read and Translate Information –read maps –read charts, tables, graphs –read time lines –use reference materials	**Read and Translate Information** –read maps –read coordinates on a globe –read charts, tables, graphs –use reference materials	**Read and Translate Information** –read maps and globes –read charts, tables, graphs
Analyze and Evaluate Information –select best source –distinguish between fact and opinion –resolve problems –categorize information –identify best evidence –draw conclusions from graphs, tables, charts –identify bias –recognize assumptions	**Analyze and Evaluate Information** –identify primary/secondary sources of information –draw conclusions from graphic information –select best source –distinguish between fact and opinion –evaluate evidence/draw inferences –recognize assumptions –identify main idea in political cartoons	**Analyze and Evaluate Information** –draw conclusions from graphic information –follow logical argument –identify primary/secondary sources of information –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

Instruction for Thinking in Social Studies

For the most part, the Maine teachers on the social studies committee have been disappointed with student performance on questions requiring higher order thinking, but at the same time, surprised at the basic, lower-level knowledge that students apparently lack. MEA results lead one to suspect that many students (or teachers) emphasize facts in isolation, rather than the relationships among ideas. Understanding the latter is essential for both the recalling of discrete information and the use of it for higher order thought.

There is no convincing evidence that students totally lack higher order thinking skills. Students are relatively successful on some of the critical thinking questions that require minimal content knowledge. Children use higher order thinking frequently in real life when they make decisions about which brand of a product to buy, how to divide up chores, what rules are fair and how to change them, etc. However, students tend not to apply their thinking skills to answer many social studies questions. Interestingly, there are questions in economics that show most students can do higher order thinking (e.g., applications of supply-and-demand and other concepts affecting pricing). Yet, in history, even when all the prerequisite knowledge is there, students tend not to reason out answers. This could be the real explanation of poor performance on questions involving time and

chronology. Identifying sailing vessels as the earliest form of transportation instead of trains, steamboats, etc. should not be as difficult as the results show. Students know that sailing vessels were used in ancient times or, at least, that they were used by Columbus. Apparently, however, many students do not see the relevance of this information to the question. Students' sequencing of events illustrates the same problem. How can a system of government be established in a land before it is "discovered"? For some reason, perhaps because of the way we teach, students must perceive history as a body of knowledge to be memorized rather than an area requiring as much thinking as other areas.

The greatest need seen by the social studies advisors is for the integration of subject matter. Many students have difficulty making connections among ideas, seeing commonalities and differences across time and cultures, identifying parallel situations, etc. For example, many high school students do not recognize the Senate's actions in rejecting the nomination of Robert Bork to the Supreme Court (described to them) as an application of checks and balances, a concept they certainly encountered in the study of U.S. government or post-colonial U.S. history.

A potential explanation of this problem could be the chronological organization of history texts and teachers' reliance on the text as a curriculum organizer. A chronological approach is the logical way to record history. Yet, a curriculum tied too closely to the text (in history or any other social studies area) may not be conducive to instruction which highlights the relationships of ideas across time or social studies disciplines. Perhaps the use of textbooks as references to answer broad questions would be more appropriate. A thematic approach to social studies instruction might be considered by teachers and curriculum planners. However, done poorly, switching to such an approach could do more harm than good. Whatever approach is followed, it is essential that students learn to make the connections among ideas, leading to deeper understanding of important social studies concepts. Stressing the integration of ideas will, by necessity, stimulate higher order thinking.

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, taken from the same humanities area, illustrate these three categories.

Barber of Seville, Carman and *Madame Butterfly* are all famous
A. musicals.
B. operas.
C. symphonies.
D. ballets.

AREA: Performing Arts
OBJECTIVE: Forms, Elements, Techniques

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

Use this dialogue from a play to answer the question at the right.

Abigail: "But I can't pay the rent."
Mr. Butler: "You must pay the rent!"
Abigail: "Please give me more time."
Mr. Butler: "Your time is up!"
Herbert: "I'll pay the rent."

How would the character of Herbert MOST LIKELY be played?

A. nervously
B. boldly
C. shyly
D. confusedly

AREA: Performing Arts
OBJECTIVE: Meaning and Purpose

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

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

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

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

Grade 8

LITERATURE

Forms, Elements, Techniques
- –setting of story
- –theme of story
- –recognize literary devices (e.g., onomatopoeia, metaphor, simile) in a poem
- –recognize genre (e.g., limerick, fable)
- –define periodical literature
- –associate literary form to performing art (script to play)

Meaning and Purpose
- –interpretation of poetry
- –tone of a poem
- –effect of poetic techniques on poem meaning
- –purposes of different genres (e.g., folktale)

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

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

Grade 11

LITERATURE

Forms, Elements, Techniques
- –story theme, setting, etc.
- –recognize literary devices (e.g., onomatopoeia, simile, metaphor) in a poem
- –recognize genre (e.g., limerick, fable)
- –define periodical literature
- –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
- –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 famous quote with speaker
- –role of literature in cultural transmission
- –identify famous poets
- –understand common themes of famous works
- –associate literary genre with a historical period
- –associate a famous American author with his/her works

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)

Grade 4	Grade 8	Grade 11
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 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	**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
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	**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 –identify characteristics of classic architecture of ancient civilizations –associate words with a period of history –evolution of languages –predominant language/second language in regions	**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
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.	**PERFORMING ARTS** **Forms, Elements, Techniques** –understand aspects of stage direction –function of stage direction in particular excerpt from play –role of the play director –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, etc. –understand range of singing voices	**PERFORMING ARTS** **Forms, Elements, Techniques** –understand aspects of stage direction –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
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	**Meaning and Purpose** –effects of stage lighting –setting, characterization in play excerpt –meaning/effect of using particular instruments –understand music differs culture to culture	**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 –classify famous composers –identify the national anthem by name –associate types of performers with period in history –associate costumes with a historical period	**Social/Historical Perspectives** –instrument families –origins of particular types of music –associate types of dance with time period –recognize names of composers	**Social/Historical Perspectives** –origins of particular types of music –associate types of performing arts with time period –recognize names of performers in different areas

Grade 4	Grade 8	Grade 11
–social function of symphony concert	–associate famous performers with their craft –recognize famous American composers	–associate famous performers with their craft or time period
LANGUAGE	**LANGUAGE**	**LANGUAGE**
Forms, Elements, Techniques	**Forms, Elements, Techniques**	**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	–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	–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	**Meaning and Purpose**	**Meaning and Purpose**
–rationale and meaning of highway signs –rationale and meaning of international symbols –rationale and meaning of trail signs	–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	–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	**Social/Historical Perspectives**	**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	–recognition of linguistic chauvinism –importance of literacy in world relations –why English is the national language –concept of regional accents	–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
RELIGION/PHILOSOPHY	**RELIGION/PHILOSOPHY**	**RELIGION/PHILOSOPHY**
Forms, Elements, Techniques	**Forms, Elements, Techniques**	**Forms, Elements, Techniques**
–recognize religious and non-religious holidays –associate religious holidays with the appropriate religion –recognize structures as places of worship	–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 form used in religious worship	–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 anthem (national, religious) –meaning of reincarnation

Grade 4	Grade 8	Grade 11
Meaning and Purpose –recognize a person's philosophy from a short passage –recognize fallacies in reasoning from short passage –understand purpose of hymns in religious services	**Meaning and Purpose** –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 –interpret brief statement from the Constitution –define atheism –apply a given philosophy to a scenario and make prediction	**Meaning and Purpose** –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
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 –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	**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 –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

Instruction for Thinking in the Humanities

Humanities instruction is a responsibility of teachers in every subject area, and should not be considered an "added burden" for a school district or for particular teachers. The humanities program must be based on a well articulated curriculum and should be regularly evaluated as other school programs are.

Examining the framework for the humanities and the lists of concepts, topics, and skills associated with the humanities areas points up the relevance of the objectives to all curricular areas. The importance of the humanities, however, is probably communicated best by the column readings of the framework, rather than the humanities areas of literature, the visual arts, etc. The MEA assesses students' knowledge of **forms, elements, and techniques** because students need a basic knowledge of each humanities area just as they need basic information in any other subject. Such a foundation is essential for further contemplation, discussion, or application of the information. Attention to **meanings and purposes** broadens students' understanding of the humanities areas, but it also calls upon the analytic and evaluative skills so important for students to develop.

Most important are the **social and historical perspectives** associated with humanities concepts. In the discussions of "instruction for thinking" in the other school subjects, the need for establishing the connections between ideas was a common theme. Such relationships make isolated bits of information meaningful, memorable, and relevant to students. The role of the arts as means of expressing the values, philosophies, and concerns of the times should not be overlooked as a vehicle for enhancing students' understanding of their own and other cultures. The importance of language (and language barriers) to the interactions of individuals and groups, the impact of religion on ways of life throughout history, and, in turn, the impact of history on the arts, language, religion, and philosophy are critical to our understanding of our world — a major goal of education and academic study.

Thus, the humanities, as defined in the MEA, offers a means to improve instruction in all areas, both in terms of understanding the content of the different disciplines and developing the thinking skills students need in life. As for implications regarding instructional techniques, these were discussed in the sections for the other subject areas. The primary recommendation here is to incorporate humanities instruction throughout all school curricula — not as an added responsibility, but as a way of improving what is already being done.

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