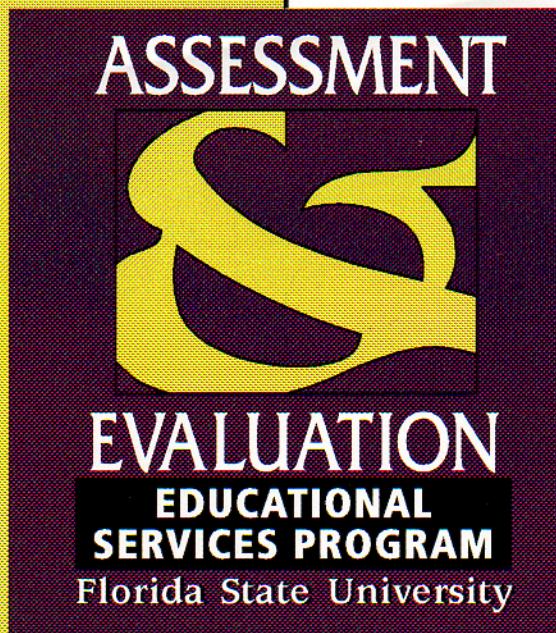


STATEWIDE ASSESSMENT

- **Listening and Verbal Communication Skills**
- **Information Literacy Skills**
- **Problem-Solving Skills**



**Feasibility Study
November 1997**

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**STATEWIDE ASSESSMENT OF
LISTENING AND VERBAL COMMUNICATION SKILLS, INFORMATION
LITERACY SKILLS, AND PROBLEM-SOLVING SKILLS**
Feasibility Study

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**STATEWIDE
ASSESSMENT OF**

- LISTENING AND
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- INFORMATION
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- PROBLEM-SOLVING
SKILLS**

**Feasibility Study
November 1997**

EXECUTIVE SUMMARY

Purpose

The purpose of this study was to determine possible designs and potential costs associated with development of a sample-based assessment of students' proficiency in three areas—listening and verbal communication, information literacy, and problem-solving skills. Four major factors influence the feasibility of conducting these assessments. They are costs, time, administration requirements, and computer access.

- **Costs.** Costs reported in this study include estimates for development, pilot testing, and production of measurement instruments. These costs do not include those associated with training test administrators, ongoing administration, scoring, reporting and archiving student records, or adaptations such as communication boards, visual supports, or trained interpreters that would be needed for some students.
- **Time.** Time has been estimated as 12 months for the development, production, and pilot testing of instruments in each assessment skill area.
- **Administration.** It is anticipated that for each area of assessment, approximately 3,500 students at each of three selected grade levels will be involved in the sample-based study. Other administration requirements vary and are reported separately for each skill area.
- **Computer Access.** Computer access is essential for some assessment modules. The Florida Office of Information Technology will complete a microcomputing resources survey during the fall of 1997. Results of this survey will help determine the feasibility of developing and administering each of the statewide assessments, including individualized administration of assessments that could otherwise be in a print format.

Section A: Listening and Verbal Communication Skills

Assessment design and construction are critical elements because, as nearly as possible, the skills must be measured exactly as they have been defined and in exactly the same way for each student. These considerations place extreme limits on assessment feasibility. For listening and viewing tests, major factors are video and CD-ROM costs, managing the testing environment, and developing rubrics for scoring constructed responses. For speaking tests, major factors are logistics and providing time to administer individual assessments, recording and managing video formats, storing and retrieving video recordings, developing rating protocols, and recruiting and training raters.

Total administration time for speaking tests will be about 15 minutes for an elementary student and 20 minutes for each student at the two higher grade levels. Administration time for listening tests will be about 45 minutes for each group in each grade. The basic costs would be about \$688,000 for listening and \$400,000 for speaking—a total of \$1,088,000 for development

and pilot testing of a statewide assessment at three grade levels. Alternatively, the Department of Education (DOE) could provide districts with either standardized measures or rating instruments developed by the DOE for classroom observation of student behaviors to assess levels of proficiency for listening and speaking skills.

Section B: Information Literacy Skills

The fidelity of the measurement method is of particular importance in determining the extent to which students can access and use electronic information sources. Three assessment modules seem reasonable: (1) 30 to 40 constructed-response and multiple-choice items administered to groups of students—administration time of 45 minutes; (2) on-line searches with constructed responses to items—about 1 hour for each small group; and (3) a portfolio of multimedia assignments in a research report format—about 2 weeks for each class.

The assessment of the first module is feasible. The feasibility of assessing the other two depends on the results of the microcomputing resources survey. Print or computer files would be required to administer the first module; computer access would be required for on-line searches and research reports. Detailed scoring rubrics also would be required. Potential costs for development and pilot testing for print administration is estimated at \$694,000. Potential costs for development and pilot testing for print and computer-administered (CD-ROM) assessment would be approximately \$733,000.

Section C: Problem-Solving Skills

The assessment of problem-solving skills will be effective to the degree that it measures across academic areas and involves a variety of complex real-life situations. Any problem-solving assessment must require *select*, *generate*, and *explain* responses. These can be addressed in multiple-choice and constructed-response formats.

Because of the relationship to information literacy, a two-part assessment of these skills may be desirable—the first for skills unique to problem-solving tasks and the second for information skills integral to problem solving, but excluding any that apply only to information literacy. Though not essential, this division allows outcomes of this assessment to be compared with those from the information literacy assessment.

This assessment is feasible. It could be undertaken at any time because it can be managed in a print format. Assessment administration time has been estimated as 30 minutes for an elementary group and 45 minutes for each class at the two higher grade levels. Although print administration is feasible, the assessment could also be administered by computer. The cost for development and pilot testing for print administration would be about \$734,000. The cost for development and pilot testing for print and computer-administered (CD-ROM) assessment would be approximately \$770,000.

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**Feasibility Study
November 1997**

BACKGROUND

Previous Initiatives

Measurement of student performance is not a new development in the state of Florida. The Department of Education (DOE) has a track record in performance testing. This record includes the performance tests developed in vocational performance areas, the *Florida Writes!* assessment program, the DOE's student assessment program called the Florida Comprehensive Assessment Test (FCAT), and the teacher certification testing program.

At the present time, there is no statewide assessment of the skills of K–12 students in listening and verbal communications. However, several years ago, the DOE supported a feasibility study assessing students' speaking and listening skills with the CLAST (Taylor, 1990). The Florida teacher certification examinations in Spanish, German, and French also contain speaking and listening subtests.

The DOE also has made strides in expanding the assessment of skills in locating and using informational resources through the new FCAT for reading requiring students to read and analyze extensive reading passages as opposed to more traditional brief paragraph selections. However, the nature of this exam does not require the performance of the broader range of information literacy skills such as finding information in printed materials, locating desired printed materials, and locating and using information through other means such as the Internet, ERIC, microfiche, and related searches.

Finally, the shift to testing for real-world problem-solving skills has been one of the most focused initiatives directed toward the measurement of student skills in mathematics. The FCAT mathematics test contains word problems that are more complex than previous minimum competency tests but are not at the same level of sophistication as the Scholastic Assessment Test. Even though some of the test items address "a variety of complex, real life problems," the focus of the test is on the application of mathematics skills. In complex real-life problem situations, the application of other academic skills also would be required.

The present study extends the previous initiatives concerning the outcomes of education in three areas—listening and verbal communication, information literacy, and problem solving. These strategies and initiatives originate from the Florida Department of Education Strategic Plan for 1996–97. (See Table 1.)

Table 1**Strategies and Initiatives for Present Study**

Listening and Verbal Communication Skills
Strategy 1.1.2.4 The Department of Education will continue to implement a statewide assessment system to measure student performance in writing, listening and communication skills standards.
Initiative: The Student Assessment Services Section will initiate a feasibility study to determine possible designs and potential costs associated with the implementation of a sample-based assessment of students' proficiency in listening and verbal communication skills.
Information Literacy Skills
Strategy 1.1.4.4 The Department of Education will implement an assessment system to measure a statewide sample of student performance in locating and using information resources.
Initiative: The Student Assessment Services Section will initiate a feasibility study to determine possible designs and potential costs associated with implementation of a sample-based assessment of students' proficiency in locating and using information resources, including both electronic and hard copy resources.
Problem Solving Skills
Strategy 1.1.5.4 The Department of Education will implement an assessment system to measure a statewide sample of student performance in applying academic skills to solve a variety of complex, real life problems.
Initiative: The Student Assessment Services Section will initiate a feasibility study to determine possible designs and potential costs associated with implementation of a sample-based assessment of students' proficiency in applying academic skills to solve a variety of complex, real life problems.

Defining the Skills

The first issue of assessment is knowing what will be measured. Performance and proficiency in skills of listening and verbal communication, information literacy, and problem solving are rooted in Florida's Blueprint 2000 (Florida Commission on Education Reform and Accountability, 1996), particularly as expressed in Goal 3: "Students successfully compete at the highest levels nationally and internationally and are prepared to make well-reasoned, thoughtful,

and healthy lifelong decisions” (Florida Department of Education, 1996–97, p. 3). These skills directly support the foundation skills and workplace competencies that are essential for high school students entering the workforce and pursuing additional education (SCANS—Secretary’s Commission on Achieving Necessary Skills, U.S. Department of Labor, 1991). The SCANS foundation skills and workplace competencies are listed in Table 2.

Table 2

SCANS Foundation Skills and Workplace Competencies

Foundation Skills	Workplace Competencies
<p>BASIC SKILLS: Reads, writes, listens, performs arithmetic and mathematical operations, and speaks.</p> <p>THINKING SKILLS: Thinks creatively, makes decisions, solves problems, visualizes, knows how to learn, and reasons.</p> <p>PERSONAL QUALITIES: Displays responsibility, self-esteem, sociability, self-management, and integrity and honesty.</p>	<p>RESOURCES: Identifies, organizes, plans, and allocates resources (time, materials and facilities, money, and human resources).</p> <p>INTERPERSONAL: Works with others (participates as a team member, teaches others new skills, serves clients/customers, exercises leadership, negotiates, and works with diversity).</p> <p>INFORMATION: Acquires and uses information (acquires, evaluates, organizes, maintains, interprets, and communicates information; uses computers to process information).</p> <p>SYSTEMS: Understands complex inter-relationships (understands systems, monitors and corrects performance, and improves or designs systems).</p> <p>TECHNOLOGY: Works with a variety of technologies (selects and applies technology and maintains and troubleshoots tools and equipment).</p>

Goals from Florida’s Blueprint 2000, together with the SCANS skills and competencies, have guided the development of the Sunshine State Standards. The Sunshine State Standards contribute to the definition of performance expectations in each area of this study. These standards are specific for learning outcomes expected as a result of education.

For example, one of the standards for listening, viewing, and speaking at grade levels 9–10 is

Standard: The student uses viewing strategies effectively.

- 1: Determines main concept and supporting details in order to analyze and evaluate nonprint media messages.
- 2: Understands factors that influence the effectiveness of nonverbal cues used in nonprint media, such as the viewer’s past experiences and preferences, and the context in which the cues are presented.

Florida's Sunshine State Standards have guided the development of the statewide curriculum frameworks used in Florida's elementary, secondary, and postsecondary education programs. The relevant standards are presented in the appendices of each section of this report.

Table 3

Sunshine State Standards

Section	Standards
Listening and Verbal Communication Skills	Appendix A-1 Listening, viewing, and speaking standards
Information Literacy Skills	Appendix B-1 Reading and writing standards
Problem-Solving Skills	Appendices C-1 and C-2 Math, science, social studies, and other academic skills standards

In addition to the Sunshine State Standards, several other sources provide specific guidance in defining the skills to be measured along with "lessons learned" from the history of previous assessment efforts. To support the design of an appropriate assessment plan, each section of this study also includes a review of assessment instruments and approaches together with information on validity and reliability of measurement efforts.

In Section A: Listening and Verbal Communication Skills, the Speech Communication Association standards for elementary and high school students are included along with a sample test and sample assessment items. In Section B: Information Literacy Skills, the American Library Association standards, a set of skills known as the "Big Six," and sample items are included to provide a detailed definition of information literacy skills. Finally, in Section C: Problem-Solving Skills, rather than an association's definition of the content, a review of several decades of research is included that identifies several comprehensive research-based models and approaches to problem-solving skills. Included in the appendices of this section are 31 problem-solving tasks identified in this review, sample items, stimulus and response requirements, a comparison to information literacy skills, and a comparison to the SCANS thinking skills.

Approaches to Assessment

There are several points to keep in mind in selecting or developing an approach to any new statewide assessment of student performance. First, after clearly describing the skills to be assessed, the approach should take into consideration the feasibility of measuring the particular skills. Generally speaking, practical, social, and privacy issues will exclude the measurement of certain skills. For example, any measurement approach should exclude offensive or intrusive probes into personal opinions, attitudes, ethnic or family background, and religious or cultural values. In addition, any measurement approach should exclude measurement practices that would be impractical or unwieldy, such as following and observing each student in a variety of everyday life situations.

Several other issues require consideration in the development of any assessment approach. These include the bias inherent in observers or raters of performance skills, the limits on the generalizability of direct performance measures, and the logistical requirements associated with equating scores from one performance assessment to the next. Equating becomes particularly problematic when individual speaking performances, for example, are stored on videotape in one year's assessment and then must be retrieved for the equating process.

Three other factors are of particular importance in designing any new statewide assessment in the targeted skills. These factors are validity, reliability, and costs.

Validity

The most comprehensive definition of validity was given by Messick (1995):

Validity is an overall evaluative judgment of the degree to which empirical evidence and theoretical rationales support the *adequacy* and *appropriateness* of *interpretations* and *actions* based on test scores or other modes of assessment (Messick, 1989). Validity is not a property of the test or assessment as such, but rather of the meaning of the test scores. These scores are a function not only of the items or stimulus conditions but also of the *persons* responding as well as the *context* of the assessment. In particular, what needs to be valid is the meaning or interpretation of the scores as well as any implications for action that this meaning entails (Cronbach, 1971). The extent to which score meaning and action implications hold across persons or population groups and across settings or contexts is a persistent and perennial empirical question. This is the main reason that validity is an evolving property and validation a continuing process. (p. 5)

The validity of an assessment can change with the density of the specific content on individual topics, particularly in the performance assessments. The content validity concerns are somewhat different for each area. For example, a high level of knowledge of particular topics such as art, music, math, science, history, or current events makes it easier for someone to listen and then communicate about the content. Yet, the same high level of knowledge can interfere with the demonstration of information literacy and problem-solving skills because examinees who have *content mastery* are more likely to express what they *already know* than to use the processes required for demonstration of the skills. At the same time, lack of any knowledge of terminology and principles or of any related experiences may be equally risky for all areas, making it difficult to interpret the content and to apply the skills called for in an assessment task or individual test item.

A multifaceted strategy that includes the following elements can enhance the validity of each assessment:

- clearly define the respective areas of listening and verbal communication, information literacy, and problem solving
- sample a variety of content and topics across assessment items that are considered appropriate for the targeted age groups
- limit vocabulary to levels that are no higher than the appropriate grade level
- deliberately construct and edit language to simplify without being condescending
- involve students in the review of assessments

Additional strategies for listening and verbal communication, information literacy, and problem solving appear in separate sections, respectively.

Reliability

Messick's (1995) definition of validity includes reliability (generalizability: "The extent to which score meaning and action implications hold across persons or population groups and across settings or contexts," p. 5). The issue of reliability is integral to large-scale assessment used for accountability purposes; it is less of a concern for classroom-based materials used for instructional purposes (Katims, Nash, & Tocci, 1993, p. 35).

Several approaches have been explored over the past decade as part of efforts to develop newer, more complex, and authentic assessments. These efforts respond to the call for

educational reform to focus on developing capabilities that generalize across subject-matter domains (California Department of Education, 1990; National Council of Teachers of Mathematics, 1989; National Research Council, 1993, as cited in Sugrue, 1994 and in Doyle, 1994).

Administration formats include paper/pencil, demonstrations, computer-administered tasks, hands-on tasks, and combinations of these in group or station activities and complete experiments (Educational Testing Service, 1987). Behavioral scales, performance ratings, and teacher observations are available for consideration (Wassermann, 1987).

Reports on portfolios, products, and hands-on assessment with equipment and materials have appeared frequently as creative approaches, stopping short of full development of tests (Doyle, 1994; Educational Testing Service, 1987; Pandey, 1990; Wasserman, 1987). In one report, teachers echo the concerns of others: lack of fairness in evaluating answers, fear that items may be too difficult or inappropriate, and increased demand for time (Katims, Nash, & Tocci, 1993). Baker, O'Neil, and Linn (as cited in Baxter, Elder, & Glaser, 1994, p. 2) concluded that "a better research base is needed to evaluate the degree to which newly developed assessments fulfill expectations."

Hands-on, laboratory, or direct performance assessments have evolved from untested assumptions and, when tested, results have shown that these assessments have limited generalizability (Linn, Burton, DeStefano, & Hanson, 1994; Shavelson, Baxter, & Gao, 1993; Shavelson, Baxter, & Pine, 1992; Shepard, 1991 & Smith, 1981, as cited in Shavelson, Baxter, & Pine, 1992). Research reports have shown that task variability is considerable and that such tests are unlikely to distinguish students with different instructional histories and are highly sensitive to the methods of measurement.

Some strategies that hold promise for improving the reliability of authentic performance assessments are

- carefully defining the outcomes to be measured and developing rating sheets, observation checklists, and/or scoring rubrics to target those same outcomes
- increasing the number of discrete tasks sampled
- carefully constructing performance assessments to measure the application of specific knowledge and procedures

- using more than one method for assessing task performance
- requiring examinees to systematically record steps, processes, and reasoning formats using scientific notebooks, computer simulations, or other records of documentation; and using this information as part of the assessment

The suggestion of using multiple methods of measurement is a logical progression from earlier methods. In the 1960s and 1970s, criticism concerned the limits of multiple-choice and constructed-response items. In the 1980s, there was a swing to authentic approaches to assessment. The more recent findings in the 1990s indicate that these authentic measures are equally limited, or even more limited, when used as the sole measure of an individual's capabilities.

For norm-referenced methods of assessment in multiple-choice and short-answer formats, reliability can readily be established with traditional methods of test development and reliability measures (test-retest, equivalent forms, split-half, Kuder-Richardson).

Reliability can be defined and measured in a number of ways that depend on the assumptions made. For domain-referenced methods of assessment, effective learning can lead to high performance of most examinees, thereby reducing the between-individual variance, and leading to a low numerical value for reliability (Gronlund, 1985; Levy & Goldstein, 1984). Because of this characteristic, less traditional methods of determining reliability will be more appropriate for domain-referenced assessments (Linn, 1979; Hambleton et al., 1980—all cited in Gronlund, 1985). The selection of an appropriate item response theory (IRT) is useful in such testing by using a “model of examinee performance in which the probability of an examinee giving a particular response to an item is completely determined by the examinee’s ability and the characteristics of the item” (Angoff, 1982, as cited in Gronlund, 1985, p. 477).

Cost

Factors influencing cost include acquisition vs. item development, classification of subject matter (domains), item storage and management, administration, scoring, reporting, software and hardware features, collection of validity and reliability data, monitoring and training, access and security, usefulness of the results, testing and reporting requirements (Millman & Arter, 1984, as cited in Naccarato & Miller, 1987). The information in this report

addresses these major concerns of costs and provides some options for each of the three areas of skills.

Sampling and administration issues must be addressed as part of the assessment design. For instance, if individual students could be sampled from a frame that listed all students in the state, an N of approximately 400 would be required to estimate statewide means or proportions with accuracy of plus or minus 5% and a confidence level of 95%. Selecting students nested in schools and classrooms reduces the accuracy of parameter estimates although stratification tends to increase accuracy. The actual number of students needed to meet the requirements of plus or minus 5% accuracy and 95% confidence cannot be calculated precisely but selecting a number seven or eight times as large as required by simple random sampling is estimated to be adequate for meeting the stated requirements.

The recommended approach to statewide assessment will involve a random sample of 100 schools stratified by region of the state, school size, and school achievement. Then within each school, one classroom of 25 to 35 students would be selected for participation in the assessment. As part of this assessment, it will be necessary to obtain permission from selected schools and teachers to administer the tests and to develop a testing schedule. Other practical considerations involve training of administrators and staff, managing the production and delivery of test materials and answer documents, and producing data files for item analyses, reliability, and bias studies by grade level.

The possible assessment approaches and the feasibility statements presented in this study take into account factors of cost and time as well as practical problems associated with reliance on complex human judgment in assessing performance and rating constructed responses. These and other issues will require thoughtful consideration in the development and review of any new statewide assessment initiative.

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**STATEWIDE
ASSESSMENT OF
LISTENING AND
VERBAL
COMMUNICATION
SKILLS**

**Feasibility Study
November 1997**

STATEWIDE ASSESSMENT OF LISTENING AND VERBAL COMMUNICATION SKILLS

Feasibility Study

Definition of Skills

Assessment of student performance in listening and verbal communications is the focus of this section. As defined by the Sunshine State Standards (Appendix A-1), these skills areas include listening, viewing, and speaking. Specification of communication skills also appears in a list of essential speaking and listening skills from the Speech Communication Association ([SCA, Appendices A-2 and A-3]; SCA, 1994, 1996; Backlund, 1985; Bassett, Whittington, & Staton-Spicer, 1978).

Sunshine State Standards

Skills for listening and verbal communication, as reflected in the Sunshine State Standards (Appendix A-1), include effective use of listening, viewing, and speaking strategies. These standards provide statements to more completely describe the skills expected at each grade level. However, many of these statements are not specific enough for immediate translation into measurable student behaviors.

Speech Communication Association Skills

A separate list of skills to consider along with the Sunshine State Standards originates from the Speech Communication Association (SCA, 1994, 1996; Backlund, 1985; Bassett, Whittington, & Staton-Spicer, 1978). The SCA has lists of essential skills in speaking and listening for elementary school students (Appendix A-2) and for high school graduates (Appendix A-3).

A number of other studies have listed sets of skills for speaking and listening. For example, Brown, Burnett, Jones, Matsumoto, Langford, and Pacheco (1981) detailed the school's role in the development of these skills, how to organize communications instruction, and "promising practices" of elementary and secondary teachers in Massachusetts. Backlund (1983), when reviewing a number of different lists developed in seven states, recognized a wide variance in the listening skills and concluded that there was no universally accepted definition of listening.

Even though the separate listings may vary from one instrument to another, the lists of skills from other studies usually appear in the SCA elementary and high school lists. For

example, the Basic Skills Improvement Policy adopted by the Massachusetts Board of Education (Brown et al., 1981) specified 11 listening skills and 14 speaking skills to be mastered by secondary students. All of these skills appear in the SCA competencies.

Elementary Education. The SCA skills statements for elementary students express the mastery level for sixth-grade students but can be scaled down for use at lower grades. These skills, as listed in Appendix A-2, reflect *practical* and *teachable* skills. Elementary students should be able to perform the skills, which can be verified by assessment procedures.

The areas of communication skills for elementary students include specific skills and examples of home, school, and community situations that utilize each skill. These areas include

- communication codes (verbal and nonverbal)
- functional skills
- interaction and message strategy skills
- receptive and evaluative skills

High School. The SCA skills statements for high school graduates express functional, educational, and general skills. *Functional* skills are needed by adults to perform successfully in adult life. *Educational* skills are teachable in public schools. *General* skills are needed by all high school graduates in the United States. These skills appear in Appendix A-3.

The areas of communication skills for high school graduates include specific skills and examples of occupational, civic, and daily applications for each skill. These areas include

- communication codes (verbal and nonverbal)
- oral message evaluation
- basic speech communication skills
- human relations

Review of Assessment Strategies

Measures of *speaking skills* have most often been performance tasks with ratings assigned to particular speaking competencies. Measures of *listening skills* have included requirements for comprehension of narrative or descriptive discourse, exposition, persuasion, inferential reasoning, and literal comprehension. Formats and methods have included multiple-choice and constructed-response items, presented in written or spoken form (such as a tape recording or an examiner's reading of questions and choices). Stimulus formats also have included videotapes.

Viewing skills, as part of listening and verbal communication tasks, have not been treated as a separate set of skills in the various instruments and reports on listening and speaking skills. However, these skills often appear within the definition of listening skills. For example, the Generalizable Vocational Communications Skills Assessment (Greenan, 1985) and the SCA (1994, 1996) include attending to nonverbal cues as part of the domain of listening skills.

Assessment Instruments

A review of instruments used in assessing listening and speaking skills shows the variety of skills covered, the age groups assessed, formats, administration methods, and time requirements. The items that follow are reviews of assessment instruments that were identified as measures of listening and speaking skills.

- Morreale, Moore, Taylor, Surges-Tatum, and Hulbert-Johnson's (1993) "The Competent Speaker" (CS) speech evaluation form for higher education was developed by the SCA and involved representatives of 12 academic institutions. The instrument was designed to assess public-speaking behaviors, and it conforms to the SCA criteria for assessment. It had also undergone validity, reliability, and bias testing. The main features of the assessment are listed below.
 - assesses eight competencies of public-speaking behavior
 - assesses both verbal and nonverbal behavior
 - does not assess "molar/general traits" such as charisma or dynamism
 - provides a holistic assessment of remote preparation skills
 - does not assess listening skills
 - provides for component (atomistic) or holistic assessment
 - assesses proficiency (degree of competence)
 - provides descriptions of "competent" responses as anchors
 - assesses without cultural bias
 - provides guidelines for training in effects of biases and related psychometric issues such as use of rating scales
- The "Conversational Skills Rating Scale" (CSRS) (Spitzberg, 1995) was designed as an assessment of interpersonal competence in the context of conversational skills. The scale is designed for self-rating or observer rating of proficiency. It assesses behavioral items, such

as speaking rate, articulation, posture, and use of gestures, and molar items, such as appropriate interactive behaviors. The CSRS takes 5 to 7 minutes to complete. Behaviors assessed include qualities of speaking such as rate and articulation, proxemics and related body positions and movements, expressiveness, questions asked during conversation, topics of conversation, exchange of conversational turns with a partner, and use of time in speaking relative to a partner. The assessment guidelines address 25 factors of conversational skills.

- Rubin, Daly, McCroskey, and Mead (1982) reviewed 45 instruments for K–12 students, and Rubin and Mead (1984) updated this review. Thirty-four of the tests in the updated review applied to students at Grade 5 and above. Most listening tests measure literal comprehension; some include listening for directions, recognizing the speaker's purpose, or making inferences and summarizing. Most speaking tests require a speaking performance on various topics and assigned ratings. Many of the listening tests use multiple-choice questions; some present questions and answer choices using spoken language—as read by an examiner or played on an audiotape. Some require the student to read test questions and answer choices, thereby confounding the measurement of listening with reading skills. Generally, speaking tests require different types of responses for elementary and older students. Elementary students provide narrative or descriptive discourse, and older students provide exposition, persuasion, and occasionally other aspects of speaking.
- Morreale, Backlund, Dallinger, Fenton, Hay, O'Leary, and Rubin (1996) screened over 3,000 speaking and listening instruments, 98 of which received further examination. Sixteen of these instruments satisfactorily met the criteria developed by the SCA (1993) standards for assessment. Ten of the instruments measure listening skills, and 6 measure speaking skills. To measure listening skills, 7 tests use multiple-choice and 3 use constructed responses. Seven of the listening tests require administration by an examiner and 3 by audiotape (one could be administered by videotape); most require group administration for 35 to 40 minutes. To measure speaking skills, 2 tests are for interpersonal measurement, one is for public speaking, and 3 measure “various dimensions of communication”; administration requires 3 to 30 minutes. Three tests, designed for young children, involve activities such as using puppets, slides, pictures, telephones, and other objects to elicit speech for public speaking, or for giving a short talk and interacting with the examiner in other ways.

- Rubin (1985) reported on the college version of the Communication Competency Assessment Instrument (CCAI). The CCAI measures listening skills and 19 speaking skills. In addition to speaking performances, it requires students to listen to a videotaped lecture and answer individually administered items about the lecture (Rubin & Shepherd, 1985). In this study, CCAI results were compared to a course exam “knowledge scores,” self-reports, and apprehension measures of 41 volunteer students in an introductory speech course. Scoring also involved holistic ratings of student competence by the teacher and an observer.
- Rubin, Welch, and Buerkel (1995) reported on the CCAI high school version (CCAI-HS). The CCAI-HS measures speaking skills only. Use of the CCAI in this study was limited to a separate sample pretest and posttest design to determine gains in skills made by students sampled from four classes in a beginning speech class in grades 9–10 and one class in grades 11–12.
- Rubin and Shepherd (1985) developed another version of part of the CCAI college test. The format is a 10-item multiple-choice version designed to measure listening skills. This test was administered to 339 students along with 3 other measures: the open-ended individually administered version, the Watson-Barker Listening Test (WBLT), and the Kentucky Comprehensive Listening Test (KCLT) with which some administrative difficulties were reported.
- Greenan (1985) reported on the Generalizable Vocational Communications Skills Assessment for use with secondary students in vocational programs in Illinois. Scoring requires student self-ratings, teacher ratings, and performance instruments in skills areas related to words and meaning, reading, writing, speaking, and listening. Speaking skills are limited to fluency, correct pronunciation, and effectiveness. Listening skills are restating or paraphrasing a conversation, asking appropriate questions, attending to nonverbal cues, and taking accurate notes.
- Goulden (1995) reported the experiences of Kansas communications educators in developing and field testing a statewide speaking and listening assessment for middle school, junior high school, and high school students. This assessment instrument uses a detailed rubric for each skill required for small group discussion and for individual speaking performances. Targeted small-group discussion skills are listening actively, participating effectively in discussions,

demonstrating awareness of and sensitivity to conversational partners, and demonstrating awareness of and concern for accomplishing group goals and tasks. Targeted individual speaking skills are using appropriate language, demonstrating an appropriate presentational or delivery style, developing effective content, and demonstrating adaptation to the specific audience.

- The Illinois State Board of Education (1982) developed a set of materials in connection with the Illinois Speech and Theater Association to assist classroom teachers in evaluating their students and instructional programs. Materials include checklists and instructional and assessment activities for the speaking, listening, and social skills listed in a K–12 state guide for teaching communication skills. Although these materials were intended for classroom use, they could be of value in designing statewide assessments.

Validity

Validity is a basic requirement for assessment instruments, and the influence of content-specific knowledge of topics for speaking tasks is of particular concern. For example, if all students address the same topic as part of a speaking assignment, then differences in knowledge about the topic are likely to influence the quality of the speaking performance. As a result, it becomes difficult to differentiate speaking skills from content knowledge about the topic. On the other hand, allowing students to choose their own topics could lead to a serious lack of standardization.

Over the past 15 years, reports on measures of listening and speaking skills have included divergent methods with sparse evidence to support their validity or reliability. Validity evidence for currently existing measures of listening skills is minimal, except for content validity. For this reason, it would be desirable to conduct validity studies of any newly developed assessment instruments. There is less evidence of validity for measures of speaking skills than listening skills.

Widely differing approaches have been used to determine validity as reflected in the following list of reports.

- In several studies, the CSRS (Spitzberg, 1995) and its subscales have been shown to have a range of correlations in the predicted direction with multiple variables related to conversational skills.

- Two convergent validity studies (Morreale et al., 1993) have shown a strong relationship of Competent Speaker scores to higher scores on the CCAI and lower scores on a measure of communication apprehension. A Rasch analysis supported the general use of the instrument for assessing public-speaking competencies.
- Sixteen of the listening and speaking tests reviewed by Rubin and Mead (1984) indicated evidence of content or construct validity and 10 reported correlations with other measures such as achievement, intelligence, and teacher ratings. Most validity coefficients ranged between .35 and .90.
- Sixteen of the K–12 speaking and listening instruments reviewed by Morreale et al. (1996) satisfactorily met the SCA criteria for assessment. Only face or content validity was reported for 8 of the 10 listening tests and 3 of the 6 speaking tests. For one listening test, correlations were .21–.48 with high school rank or grade. For another, correlations were .41, .39, and .48 with ACT English, math, and social studies. For one speaking test, significant correlations were reported with popularity ratings, self-image, and achievement, but not with intelligence. For another, pass-fail results were related to mean differences in vocabulary, gender, racial or ethnic groups, and socioeconomic status. For a third test, correlations of .68 and .84 were reported for a response rating scale and “overall assessment of two standardization subjects” (p. 39).
- For the CCAI-HS that measures high school speaking skills, overall improvement in skills was reported over time (from grades 9–10 and 11–12), with the largest gain for skills that were taught in the course (Rubin, Welch, & Buerkel, 1995).
- For the CCAI version that measures college speaking skills, correlations were .65, .52, and .75 for the CCAI total with teacher ratings, exam “knowledge score,” and observer ratings, respectively (Rubin & Shepherd, 1985).
- For the 10-item multiple-choice version of the CCAI on listening skills, correlations were .07 and .27 with the KCLT and WBLT total scores. For the open-ended individually administered version of the CCAI, correlations were .11 with the KCLT total and .39 with the WBLT total (Rubin & Shepherd, 1985).

- For the Generalizable Vocational Communications Skills Assessment, validity studies were accomplished for the overall student, teacher, and performance ratings, but not for speaking and listening separately (Greenan, 1985).
- For the statewide speaking and listening assessment developed and distributed to districts in Kansas, there were no validity data reported.
- For the Illinois State Board of Education (1982) and the Illinois Speech and Theatre Association sets of K–12 checklists and instructional and assessment activities for speaking, listening, and social skills, there were no validity data reported.

Reliability

Technical studies of currently existing measures of listening and speaking skills indicate that careful test construction could ensure acceptable internal consistency reliability. However, the extent to which scores based on a limited sample of skills would generalize to the entire sets of skills contained in the Sunshine State Standards and the lists of the Speech Communication Association is unknown.

Limited studies of reliability have been conducted for measures of different speaking and listening skills as shown in the following review of studies.

- Internal reliabilities (coefficient alpha) reported for the CSRS (Spitzberg, 1995) have been above .85, and often above .90. Reliabilities of the factor subscales have been above .80. Interrater reliability has been at .75 or higher.
- Reliability testing of the Competent Speaker instrument yielded a coefficient of .92, a Cronbach's alpha of .76, and a Cronbach coefficient of .84 in separate testing sessions (Morreale et al., 1993).
- For 19 of the 34 measures of listening and speaking skills reviewed by Rubin and Mead (1984), reliability coefficients were generally in the .70 to .90 range.
- For 8 of the listening tests reviewed by Morreale et al. (1996), internal consistency, alternate form, or test-retest reliability coefficients ranged from .53 to .90.
- One speaking test reviewed by Rubin and Mead (1984) was reported to have a test-retest coefficient of .96 and another was reported to have an internal consistency coefficient of .77.

- An interrater reliability for another speaking test reviewed by Rubin and Mead (1984) was .80.
- A third speaking test reviewed by Rubin and Mead (1984) had a 90 percent interrater agreement.
- For the CCAI measure of speaking skills reviewed by Rubin, Welch, and Buerkel (1995), alpha reliability coefficients were .74, .74, and .77 for the pretest, posttest, and total groups, respectively.
- For the Generalizable Vocational Communications Skills Assessment, reliability studies were made for the overall student, teacher, and performance ratings, but not for speaking and listening separately (Greenan, 1985).

Possible Design for Assessment

One overall design decision would be to assess listening and speaking skills separately rather than together. Appendix A-4 provides a sample listening test, and Appendix A-5 provides a sample speaking test for consideration in the design of assessment instruments and procedures for these respective skills areas. The listening assessment, if developed, would address the viewing skills as an integral part of listening.

To test knowledge and principles related to listening or verbal communication strategies, it would be appropriate to use multiple-choice and constructed-response formats. For these options, answer keys would be required for multiple-choice items and scoring rubrics for constructed-response items. Other design considerations apply to the listening and verbal communication tests respectively.

The proposed assessment for listening skills would involve the development and viewing of videotapes, with equipment or interpreter support for hearing-impaired students, and a combination of multiple-choice and constructed-response formats. Administration of the viewing component would require careful attention to the testing environment for sight-range of monitors, audio levels, and acoustics.

The proposed assessment for speaking skills would involve individual administrations of speaking performance tasks. Performances would be videotaped and scored by trained raters, or would receive real-time on-the-spot scoring by two trained raters.

Because listening involves viewing as well as hearing, the method of presenting nonverbal cues must provide consistency of presentation. Either a videotape or a CD-ROM format would serve this purpose. Such formats allow the test to be administered to groups of students, but they require careful attention to the testing environment. The frame, size, and clarity of viewing video images must allow all students to see the nonverbal cues. In addition, acoustics and other arrangements in testing rooms must allow all students to clearly hear verbal messages.

Similar requirements apply to acoustics and technical audio quality for portions of listening tests that may require the hearing of spoken words from a test administrator or from an electronic recording.

Speaking tests require individual rather than group administration. For individual student-speaking performances, it would be necessary either to videotape the performance for later scoring by trained raters or to arrange for two trained raters to do the scoring at the time of the actual performance. Each of these alternatives poses major logistical and technical challenges, and each would be exceptionally expensive and time consuming.

In addition, the concerns about visual and audio quality that apply to listening tests would apply as well to the speaking performances so that hearing and viewing ranges of speaking performances are reasonably standardized for raters.

One of the knotty issues raised earlier about topic-specific knowledge is difficult to resolve because of logistical and expense constraints. This concern is especially serious for assessing individual speaking performances.

Test Characteristics

As much as possible, Florida's assessment of oral skills should conform to recommendations made by the SCA. Relevant parts of the SCA's Criteria for the Assessment of Oral Skills are quoted in Appendix A-6.

The proposed assessment of the oral communication skills for three grade levels such as 5, 8, and 10 would be composed of two tests—listening and speaking. All students must have a clear view of the television screen. The following section describes the common characteristics of each of the two tests.

Listening test. Skills for the listening test would be taken from the SCA list of skills and the Sunshine State Standards. One exception is that students would not be asked to disclose personal preferences or attitudes.

- All stimulus materials, with subtitling, would be available on CD-ROM allowing for individualized computer-administered testing. These same materials would be available on videotape to allow group or individual administration in districts where schools may not have computer access for CD-ROM administration.
- For students who have hearing difficulties or impairments, the subtitling of the audio portions in the video segments would support the assessment process. For some students, other arrangements also may be necessary, such as the availability of an interpreter who can use sign language expressively to convey the level of spoken emphasis that may appear in some episodes.
- Storyboards and group discussion excerpts or vignettes would be used in constructing the stimulus materials.
- Video stimulus materials for the CD-ROM and videotape would be produced using 1–5 individuals. These individuals would be speaking as prescribed by the storyboard and group discussion specifications for the purpose of assessing listening skills. The stimulus materials would be designed as an interrupted program, with deliberate pausing points, thereby allowing necessary intervals for testing purposes.
- Talent to be used in preparation of the CD-ROM and the videotape would be semiprofessional staff with prior experience in group presentations, public speaking, and/or teaching.
- All responses would be elicited by multiple-choice and/or constructed-response formats. The constructed-response items would only be used when multiple-choice items seem either inappropriate or unfeasible.
- Items would be presented orally in the video format, including questions, stems, choices, and directions for completing constructed-response items.
- All multiple-choice items would require answer keys.
- All constructed-response items would require rubrics.

- Administration time for listening tests would be approximately 45 minutes for all three grade levels.

Speaking test. Skills for the speaking test would be taken from the SCA list of competencies and the Sunshine State Standards. One exception is that group discussion skills are not proposed because of standardization problems.

- The stimulus material would consist of an instructional videotape of 3–5 minutes and a set of interview questions that would be used by the test administrator to conduct an individualized interview session. The videotape would be produced using an individual to provide and explain specific directions to students on selecting a topic and preparing for their 5-minute speaking presentation. (Using a videotape for the stimulus materials provides consistency of directions and matches the media format that will be used for recording the student's speaking performance.)
- Talent to be used in preparation of the videotape would be semiprofessional staff with prior experience in group presentations, public speaking, and/or teaching.
- The instructional videotape would provide students with specific information about the speaking test and a set of 5–10 topics for their presentations.
- The students would have the option of selecting one of the given topics or selecting a topic of their choice.
- After selecting a topic, each student would be given 30 minutes to prepare the 5-minute speaking performance.
- The interview session would take about 3–5 minutes for each student in grade #1 (such as fifth grade) and 7–10 minutes for each student in grade #2 and grade #3 (such as eighth and tenth grades).
- Speaking performances of each student and the interview session will be videotaped so that interrater studies can be performed.
- Total administration time for speaking tests will be approximately 15 minutes for each student in grade #1 (such as fifth grade) and 20 minutes for each student in grade #2 and grade #3 (such as eighth and tenth grades).
- For students who have speech difficulties or impairments, arrangements must be made for adaptations to facilitate expressive communication such as sign language with an interpreter

or use of a word board. Rating sheets, related materials, and training also could require appropriate adaptation.

Construction, Administration, and Evaluation

The listening and speaking tests would require separate sets of construction, administration, and evaluation activities as described in the following sections.

Listening test. Design, development, pilot testing, and production of the listening assessment instrument, materials, and procedures would require the following activities.

- **Assemble Committees.** For each grade-level assessment, assemble two committees—development and review. Include on each committee 5 subject-matter experts who are public school teachers and university personnel.
- **Train.** Training for both the development and the review committees would include the purpose and format of specifications, development of scenario for storyboards, test item development, aural “readability” characteristics of test items, ways to avoid bias, and department security requirements. The review committee also would receive specific instructions concerning assessment of test materials for clarity, content adherence to specifications, and psychometric properties.
- **Develop Scripts and Test Items.** The development committee would review and select the skills to be measured from the SCA list and the Sunshine State Standards and would develop the scenarios and specifications for the scripts integrated with the storyboards. The scenarios and script specifications for the storyboards would be given to a scriptwriter to prepare them for production. The development committee would review, recommend changes, and approve the final scripts and the storyboards. The development committee would also develop item specifications and draft the test items to accompany the storyboards.
- **Review Scripts and Test Items.** Specifications, scripts, and test items would be reviewed by a psychometrician first and then by the review committee. The review committee would review, recommend changes, and approve the selected skills, video specifications, scripts and storyboards, item specifications, and test items.
- **Produce Sample Footage.** The videographer and instructional designer would be responsible for the selection of the talent and production of sample footage. The review committee would approve the selected talent and sample footage.

- **Produce the Video and CD-ROM.** The videographer and the instructional designer would be responsible for production of the video and the CD-ROM. The review committee would review and approve both formats prior to the pilot study.
 - **Prepare Answer Documents.** The project personnel and the development committee would be responsible for the development of the answer key for the multiple-choice section of the test and the rubrics for scoring the constructed-response items.
 - **Develop Training and Administrator's Manuals.** The project staff would produce both the training and the administrator's manuals. The manuals would include guidelines concerning the room conditions, testing conditions and requirements, and equipment requirements. For example, acoustics in testing rooms should be good enough so that no student has trouble hearing the spoken material.
 - **Conduct Pilot Study.** The pilot study would involve students in 10 classrooms with a minimum of 15 students at each grade level. The selected classrooms should represent at least 5 school districts. Four additional aspects for the pilot test are listed below.
 - 1. Scoring.** The multiple-choice section of the test would be scored using the answer key. Scoring of constructed-response items would involve two persons who will score according to developed scoring rubrics.
 - 2. Reliability.** Project staff would conduct an item analysis of the test items, including use of an appropriate IRT model, and interrater-reliability studies of all constructed-response measures.
 - 3. Validation Meeting.** A subcommittee consisting of members from both the development and review committees would review the results of the pilot test. The subcommittee would revise and approve any changes necessary to the test items or other test components.
 - 4. Production.** Project staff would complete final reviews, edit materials, and produce required copies of print and electronic formats of all materials.
- Speaking test.** Design, development, pilot testing, and production of the speaking assessment instrument, materials, and procedures would require the following activities.

- **Assemble Committees.** For each grade-level assessment, assemble two committees—development and review. Include on each committee 5 subject-matter experts who are public school teachers and university personnel.
- **Training.** Training for both the development and the review committees would include the purpose and format of specifications, guidelines for assessment of speaking skills, development of interview questions, ways to avoid bias, and department security requirements. The review committee would also receive specific instructions concerning assessment of test materials for clarity, content adherence to specifications, psychometric properties, difficulty, and potential bias.
- **Develop Scripts and Interview Questions.** The development committee would review and select the skills to be measured from the SCA list and the Sunshine State Standards. In addition, the committee would be responsible for selecting 5–10 topics to be used by students in their presentations. The committee also would develop specifications for the instructional video and the interview questions and would draft the interview questions. The scriptwriter would prepare the scripts for the instructional video. The development committee would review, recommend changes, and approve the script for the instructional video.
- **Review Scripts and Interview Questions.** Specifications, script for the instructional video, and the interview questions would be first reviewed by a psychometrician and then by the review committee.
- **Produce Sample Footage.** The scripts would be given to the videographer who would be responsible for the selection of talent and production of sample footage. The review committee would approve the selected talent and sample footage.
- **Produce Video.** The videographer would be responsible for production of the video. The review committee would review and approve the instructional video.
- **Prepare Answer Documents.** The project personnel and the development committee would be responsible for development of rating forms and scoring rubrics.
- **Develop Training and Administrator's Manuals.** The project staff would produce both the training and the administrator's manuals. The manuals would include guidelines concerning the room conditions, testing conditions and requirements, and equipment requirements.

- **Conduct Pilot Study.** The pilot study would involve students in 10 classrooms with a minimum of 15 students at each grade level. The selected classrooms should represent at least 5 school districts. Four additional aspects of the pilot test are listed below.
 - 1. Scoring.** Videotaped performance of the students would be rated. Each performance should be rated by two judges using analytic and/or holistic rating procedures.
 - 2. Reliability.** Project staff would conduct item interrater-reliability studies of all videotaped performances.
 - 3. Validation Meeting.** A subcommittee consisting of members from both the development and review committees would review the results of the pilot test. The subcommittee would be asked to revise and approve any changes necessary to the test components.
 - 4. Produce Materials.** Project staff would complete final reviews, edit materials, and produce required copies of print and electronic formats of all materials.

Statewide Assessment

Statewide assessment for both the listening and speaking tests would involve the following activities:

1. For each grade, select a random sample of 100 schools stratified by region of the state, school size, and school achievement. Within each school, randomly select one classroom containing 25 to 35 students. Middle and high school students should probably be selected from language arts classes.
2. Obtain permission from selected schools and teachers to administer tests. Develop testing schedule.
3. Produce approximately 3,500 answer documents and rating forms for each grade. Produce up to 1,000 copies of listening CDs, 20 copies of listening videotapes, and 50 copies of the speaking instructional video for each grade. Make arrangements to use school televisions and videotape players, or acquire necessary equipment.
4. Acquire 100 blank videotapes for each grade for use in recording student speech performances. Arrange for schools to use their own or district video cameras for speech test recording.

5. Deliver answer documents, listening CDs and videotapes, and instructional videotapes and blank videotapes for speaking test to participating districts. Deliver other equipment as necessary.
6. Train district administrators. Complete testing within a two-week time period.
7. Receive all testing material including completed answer documents and videotapes from districts.
8. Select, train, and monitor raters of constructed-response listening items and student speech performances. Scan multiple-choice items.
9. Produce data files for each grade level. Do item analyses, reliability, and bias studies by grade level.

Potential Costs of Assessment

The following information provides an outline of the timeline, staffing requirements, list of deliverables, and estimated cost associated with the development of the listening and speaking tests for three grade levels, such as 5, 8, and 10. The estimated costs reported in this study are limited only to the costs of development and do not include the costs of administration.

The main reason for lack of inclusion of the cost of administration for these two tests is that there are many variables that can impact the cost of administration. The administration of these two tests, especially the speaking test, would be extremely time consuming and expensive and requires a great number of well-trained staff. If district personnel do not have the necessary capabilities and resources to administer the statewide assessment, then it would be desirable to contract an outside agency or group for administration of this statewide assessment. If so, then additional administration expenses should be anticipated.

Listening test. The approximate time for the development of the listening test would be 12 months, and it will require the use of a number of professionals. Table A-1 illustrates a reasonable configuration of the core professional staff required during the development phase. The level of direction, management, psychometric, instructional, video, editorial, graphic design, and related expertise can be provided through a different staffing pattern but should cover the required areas of expertise at about the level indicated.

Table A-1
Project Staffing—Listening Test

Project Staffing			
Project Director	Half Time	Proofer	Half Time
Project Manager	Full Time	Graphic Designer	Half Time
Psychometrician	Full Time	Word Processor	Half Time
Instructional Designer/Programmer	Three Months	Graduate Assistant	Half Time
Videographer	One Month	Graduate Assistant	Half Time
Editor/Scriptwriter	Full Time	Assistant Manager	Full Time

In addition to the core project staffing, committee members would meet to accomplish the development and review activities (see Table A-2).

Table A-2
Committee Meetings—Listening Test

Committee Meetings	
Development Committee (15 members)	Five Meetings (14 days)
Review Committee (15 members)	Four Meetings (12 days)

Deliverables. The deliverables for the listening test are shown in Table A-3.

Table A-3

Deliverables—Listening Test

Deliverables	
Training Manual	Camera-Ready Copy, Electronic Copy, and 50 Hard Copies
Administration Manual	Camera-Ready Copy, Electronic Copy, and 50 Hard Copies
Grade #1 Test (such as fifth grade)	1,000 Copies on CD-ROM and 20 Copies of Videotapes
Grade #2 Test (such as eighth grade)	1,000 Copies on CD-ROM and 20 Copies of Videotapes
Grade #3 Test (such as tenth grade)	1,000 Copies on CD-ROM and 20 Copies of Videotapes
Grade #1 Answer Document	Camera-Ready and Electronic Copies
Grade #2 Answer Document	Camera-Ready and Electronic Copies
Grade #3 Answer Document	Camera-Ready and Electronic Copies
Grade #1 Test, Answer Key, and Rubrics	Camera-Ready and Electronic Copies
Grade #2 Test, Answer Key, and Rubrics	Camera-Ready and Electronic Copies
Grade #3 Test, Answer Key, and Rubrics	Camera-Ready and Electronic Copies

Total Cost. The total cost for the development of the listening test is \$688,000. The cost breakdowns by category for the development of the listening test are illustrated in Table A-4.

Table A-4

Cost Breakdowns—Listening Test

Breakdown of Cost by Category	
Personnel	\$487,500
Contractual Services	29,800
Travel	99,500
Materials and Supplies	29,500
Printing/Copying	7,500
Communication	13,300
Postage and Shipping	7,200
Equipment Maintenance	5,200
Capital Outlay	8,500
Total	\$688,000

Speaking test. The approximate time for the development of the speaking test would be six months and would require the use of a number of professionals. Table A-5 illustrates a reasonable configuration of the core professional staff required during the development phase. The level of direction, management, psychometric, instructional, video, editorial, graphic design, and related expertise could be provided through a different staffing pattern but should cover the required areas of expertise at about the level indicated below.

Table A-5

Project Staffing—Speaking Test

Project Staffing			
Project Director	Half Time	Graphic Designer	One Month
Project Manager	Full Time	Word Processor	Half Time
Psychometrician	Two Months	Graduate Assistant	Half Time
Videographer	Five Days	Graduate Assistant	Half Time
Editor/Scriptwriter	Full Time	Assistant Manager	Full Time
Proofer	Half Time		

In addition to the core project staffing, committee members will meet to accomplish the development and review activities. See Table A-6.

Table A-6

Committee Meetings—Speaking Test

Committee Meetings	
Development Committee (15 members)	Three Meetings (1–3 days)
Review Committee (15 members)	Four Meetings (1–2 days)

Deliverables. The deliverables for the speaking test are shown on Table A-7.

Table A-7

Deliverables—Speaking Test

Deliverables	
Training Manual	Camera-Ready Copy, Electronic Copy, and 50 Hard Copies
Administration Manual	Camera-Ready Copy, Electronic Copy, and 50 Hard Copies
Instructional Tape for All Three Grades	100 copies on CD-ROM and 20 Copies of Videotapes
Grade #1 Interview Questions	Camera-Ready and Electronic Copies
Grade #2 Interview Questions	Camera-Ready and Electronic Copies
Grade #3 Interview Questions	Camera-Ready and Electronic Copies
Grade #1 Rating Sheet and Rubrics	Camera-Ready and Electronic Copies
Grade #2 Rating Sheet and Rubrics	Camera-Ready and Electronic Copies
Grade #3 Rating Sheet and Rubrics	Camera-Ready and Electronic Copies

Total Cost. The total cost for the development of the speaking test is \$400,000. The cost breakdowns by category are illustrated in Table A-8.

Table A-8

Cost Breakdowns—Speaking Test

Breakdown of Cost by Category	
Personnel	\$245,000
Contractual Services	17,500
Travel	97,000
Materials and Supplies	13,000
Printing/Copying	5,000
Communication	9,000
Postage and Shipping	5,500
Equipment Maintenance	3,000
Capital Outlay	5,000
Total	\$400,000

Feasibility Statement

Listening Tests

The development and administration of listening tests to statewide samples of students at three grade levels (such as fifth, eighth, and tenth) appear to be of limited feasibility. Major concerns include high video production costs, difficulties in adequately managing the testing environment, and the need to carefully develop rubrics for the scoring of constructed responses.

Although video production costs would be high, the videotapes are required in order to provide a consistent stimulus situation that would allow students to respond to nonverbal cues. The use of this videotape method, however, presents other demands for the testing environment. For example, all students should have clear views of the monitor (television screen). For this medium, and for any audio recording or spoken words from an administrator, acoustics in testing rooms should also allow all students to hear clearly. Adaptations such as subtitling or an interpreter would be required for hearing impaired students. Interpreter adaptations present other problems associated with idiosyncratic methods of individuals who provide expressive interpretation of sign language.

Generalizability and validity are two other concerns. Even with careful test construction and acceptable internal consistency reliability, generalizability may be limited. The extent to which scores based on a limited sample of skills would generalize to the entire sets of skills contained in the Sunshine State Standards and the Speech Communication Association's lists remains unknown. In addition, the validity evidence for currently existing listening measures is minimal except for content validity. For this reason, it would be desirable to conduct validity studies of any newly constructed tests.

Speaking Tests

The development and administration of speaking tests to statewide samples of students at three grade levels (such as fifth, eighth, and tenth) appear to be even less feasible than the listening test. Major concerns include logistics and time required for administration, video recording and management demands, the need for developing adequate rating protocols, the training and personnel demands for using raters to score speaking performances, and associated time demands and expenses.

The requirements for adequately and fairly testing speaking performances create logistical and management problems. For example, speaking tests would of necessity have to be administered to students individually. In addition, speaking performances would require videotaping and scoring by trained raters or require scoring by two trained raters at the time of the individual performance.

Finally, generalizability may be limited, and validity studies would be desirable for any measures of speaking capabilities that are developed. A particular problem related to validity, mentioned earlier in this report, is the choice of topic for making a speaking presentation. If students are required to use the same content, then differences in knowledge may influence the quality of the speaking performance. Yet, if students choose their own topics, there may be a serious lack of standardization.

Alternative Approach

One alternative to statewide sampling would be for the department to make standardized measures of listening and speaking available to districts. These measures or instruments for classroom observation of listening and speaking behaviors could be administered by teachers or other district personnel. As mentioned earlier, the experiences of Goulden (1995), Brown et al.

(1981), and the Illinois Board of Education (1982) suggest that one or both of these procedures would be feasible for Florida. Both “The Competent Speaker” (Morreale et al., 1993) and the “Conversational Skills Rating Scale” from the Speech Communication Association could be adapted for classroom use (Spitzberg, 1995).

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**STATEWIDE ASSESSMENT OF
LISTENING AND VERBAL COMMUNICATION SKILLS**

Feasibility Study

Appendices

Appendix A-1: Sunshine State Standards for Listening, Viewing, and Speaking

Appendix A-2: SCA Competencies—Elementary Education

Appendix A-3: SCA Competencies—High School Education

Appendix A-4: Sample Listening Test

Appendix A-5: Sample Speaking Test

Appendix A-6: Criteria for the Assessment of Oral Skills

Appendix A-1
Sunshine State Standards for Listening, Viewing, and Speaking

Grades 3–5	Grades 6–8	Grades 9–10
<i>Standard 1: The student uses listening strategies effectively.</i>		
1 listens and responds to a variety of oral presentations, such as stories, poems, skits, songs, personal accounts, informational speeches 2 identifies specific personal listening preferences regarding fiction, drama, literary nonfiction, and informational presentations 3 carries on an extended conversation with a group of friends 4 listens attentively to the speaker, including making eye contact and facing the speaker 5 responds to speakers by asking questions, making contributions, and paraphrasing what is said	1 listens and uses information gained for a variety of purposes, such as gaining information from interviews, following directions, and pursuing a personal interest 2 selects and listens to readings of fiction, drama, nonfiction, and informational presentations according to personal preferences 3 acknowledges the feelings and messages sent in a conversation 4 uses responsive listening skills, including paraphrasing, summarizing, and asking questions for elaboration and clarification	1 selects and uses appropriate listening strategies according to the intended purpose, such as solving problems, interpreting and evaluating the techniques and intent of a presentation, and taking action in career-related situations 2 describes, evaluates, and expands personal preferences in listening to fiction, drama, literary nonfiction, and informational presentations 3 uses effective strategies for informal and formal discussions, including listening actively and reflectively, connecting to and building on the ideas of a previous speaker, and respecting the viewpoints of others 4 identifies bias, prejudice, or propaganda in oral messages
<i>Standard 2: The student uses viewing strategies effectively.</i>		
1 determines main concept and supporting details in a nonprint media message 2 recognizes and responds to nonverbal cues used in a variety of nonprint media, such as motion pictures, television advertisements, and works of art	1 determines main concept, supporting details, stereotypes, bias, and persuasion techniques in a nonprint message 2 uses movement, placement, juxtaposition, gestures, silent periods, facial expressions, and other nonverbal cues to convey meaning to an audience	1 determines main concept and supporting details in order to analyze and evaluate nonprint media messages 2 understands factors that influence the effectiveness of nonverbal cues used in nonprint media, such as the viewer's past experiences and preferences, and the context in which the cues are presented
<i>Standard 3: The student uses speaking strategies effectively.</i>		
1 speaks clearly at an understandable rate and uses appropriate volume 2 asks questions and makes comments and observations to clarify understanding of content, processes, and experiences 3 speaks for specific occasions, audiences, and purposes, including conversations, discussions, projects, and informational or imaginative presentations 4 uses eye contact and gestures that engage the audience 5 participates as a contributor and occasionally acts as a leader in a group discussion 6 organizes a speech using a basic beginning, middle, and ending	1 understands how volume, stress, pacing, and pronunciation can positively or negatively affect an oral presentation 2 asks questions and makes comments and observations that reflect understanding and application of content, processes, and experiences 3 speaks for various occasions, audiences, and purposes, including conversations, discussions, projects, and informational, persuasive, or technical presentations	1 uses volume, stress, pacing, enunciation, eye contact, and gestures that meet the needs of the audience and topic 2 selects and uses a variety of speaking strategies to clarify meaning and to reflect understanding, interpretation, application, and evaluation of content, processes, or experiences, including asking relevant questions when necessary, making appropriate and meaningful comments, and making insightful observations 3 uses details, illustrations, analogies, and visual aids to make oral presentations that inform, persuade, or entertain 4 applies oral communication skills to interviews, group presentations, formal presentations, and impromptu situations 5 develops and sustains a line of argument and provides appropriate support

Appendix A-2
SCA Competencies—Elementary Education

SOURCE: These speaking and listening competencies for elementary school students were developed by the Speech Communication Association.¹

I. COMMUNICATION CODES.

This set of skills includes the child's abilities to produce and respond to spoken English and nonverbal forms of communication (e.g., gestures and facial expressions).

	Home	School	Community
A. Speaks clearly and expressively through appropriate articulation, pronunciation, volume, rate and intonation.	<p>Speaks clearly when answering the telephone.</p> <p>Varies voice to express different feelings, (e.g., thanks for a gift, apology for a mistake, excitement at winning a prize, sorrow at seeing someone hurt.)</p>	<p>Presents an announcement clearly in class so that all students in the room can hear it.</p> <p>Uses appropriate volume and intonation when asking a question about an assignment.</p>	<p>In a restaurant, clearly orders items.</p> <p>Uses appropriate tone of voice to express disappointment or happiness to teammate.</p>
B. Uses and understands spoken language appropriate to the context (e.g., topic, purpose, audience).	<p>Participates in verbal play that involves chants, rhymes, jingles, and slogans.</p> <p>When explaining how to play a new game, adapts language to players of different ages (e.g., younger children, siblings, peers).</p>	<p>Uses various word forms appropriately (e.g., verbs, nouns, adjectives, adverbs) in describing a field trip or some other school-related activity.</p> <p>Uses appropriate linking words (e.g., because, so, therefore) when explaining a science experiment.</p>	<p>Uses a more informal style of talking with close friends than with new acquaintances or strangers.</p> <p>When talking about popular culture (e.g., music, sports, television) varies language from peer to adult listeners.</p>
C. Uses nonverbal cues that emphasize meaning.	<p>Shows appropriate attentiveness when listening to a primary caregiver.</p> <p>Describes an exciting school event to a primary caregiver with appropriate animation.</p>	<p>Shows attentiveness nonverbally when discussing an assignment (e.g., composition, science project) with the teacher during an individual conference.</p> <p>Uses nonverbal cues to indicate lack of understanding when the teacher explains a project.</p>	<p>Expresses different feelings (e.g., surprise, disappointment) to playmate through nonverbal actions.</p> <p>Observes facial and bodily actions of a friend to be aware of key mood changes of the person.</p>

¹ Speech Communication Association (1994). *Speaking and listening competencies*. Annandale, VA: Author.

II. FUNCTIONAL SKILLS.

This set of skills deals with communicating for specific purposes (e.g., informing, controlling, following social conventions, imagining, sharing feelings) in particular communication contexts.

	Home	School	Community
A. Seeks, offers, and responds to information.	<p>Describes a physical ailment so primary caregiver can understand.</p> <p>Explains to a younger sibling how to play a simple board game and highlights the most important rules.</p>	<p>Gives an oral presentation to the class about cultural beliefs.</p> <p>Presents components of a simple process (i.e., baking a cake) in proper sequence.</p>	<p>Orally gives directions to a friend for walking from one home to another.</p> <p>Summarizes rules for crossing the street when going from home to school or for riding on the school bus.</p>
B. Seeks to influence others' beliefs and actions and reacts to others' persuasion.	<p>Gives reasons when seeking permission for a special privilege (e.g., having a friend over for dinner, sleeping at a friend's house).</p> <p>Recognizes a television commercial as an attempt to sell a product.</p>	<p>Presents (and responds to) a persuasive talk to the class about a school or community project.</p> <p>Bargains with classmates to trade objects for collection (e.g., sports cards, coins).</p>	<p>In a door-to-door fund-raising campaign (i.e., selling candy for school) gives reasons to neighbor for donating to the organization.</p> <p>Takes charge in a game, explaining the rules and mediating disputes.</p>
C. Recognizes and participates appropriately in social conventions.	<p>Invites a friend to come over to his/her house to play.</p> <p>Handles telephone conversations appropriately (e.g., greeting and terminating a call, offering to take a message, identifying a caller).</p>	<p>Takes turns in a small group discussion in class.</p> <p>Introduces a visitor to the teacher or to classmates.</p>	<p>Introduces self to others in order to become acquainted.</p> <p>Greets acquaintances not seen for a while.</p>
D. Uses spoken language creatively to enjoy and participate in imaginative situations.	<p>Describes to primary caregiver recently-read story.</p> <p>Distinguishes between realistic and fantasized television programs.</p>	<p>Makes up an appropriate ending to an unfinished story read by the teacher.</p> <p>Participates in dramatic improvisation of a story or poem under the teacher's guidance.</p>	<p>Enacts a role in a skit for a community project.</p> <p>Discusses topics about the future (e.g., space exploration, homes of tomorrow).</p>

	Home	School	Community
E. Uses spoken language to express own and respond to other's feelings.	Expresses sympathy when a sibling is sad. Elicits sibling's feelings about family rules and procedures.	Explains own feelings about some school rules. Expresses satisfaction in successfully completing a difficult assignment.	Apologizes appropriately following an argument with a friend. Congratulates friends when they win something or do a job well.
F. Asks appropriate questions to clarify meaning.	Asks primary caregiver to define an unclear term used in giving directions. Asks person on the phone for an example to clarify a statement made.	Asks teacher to define a technical term used in class. Asks teacher to restate a series of ideas which are unclear.	Asks health care provider to clarify a medical diagnosis. Asks person to reorder the directions given as they are not presented sequentially.

III. INTERACTION AND MESSAGE STRATEGY SKILLS.

This set of skills encompasses the ability to participate in situations ranging from informal conversations to more planned and formal interactions.

	Home	School	Community
A. Maintains conversations (e.g., enters in, takes turns, responds to others' remarks and closes a conversation).	Takes turns when participating in a family dinner table conversation. When invited to do so, engages in and maintains conversation with a family friend.	Recognizes when it is appropriate to ask a question when the teacher gives an assignment. Initiates and builds on ideas in a brainstorming session during social studies.	Initiates, maintains, and terminates a brief conversation with an acquaintance on a shopping trip. Engages in spontaneous conversation with others prior to/following a meeting of a club or organization.
B. Presents ideas in an orderly way.	Instructs a sibling about the appropriate sequence in how to play a game. Recounts a playground event for the primary caregiver in a chronological order.	Uses a cause and effect pattern when orally reporting on a science project. Uses an introduction, body, and conclusion when giving an oral report about a community issue.	Explains how to build, construct, or assemble an object in a series or steps. Gives a friend directions for finding a community landmark in a clear sequence.
C. Clarifies and supports ideas with necessary details (e.g., examples, illustrations, facts, opinions).	Gives reasons when attempting to persuade for extension of bedtime. Elaborates observations about facts and feelings when discussing a family conflict.	Describes a character in a story with vivid and appropriate details. Supports with several reasons a solution to a problem discussed in social studies.	Tells why one fundraising project is better than another. Offers reasons when convincing a friend to engage in an activity.

IV. RECEPTIVE AND EVALUATIVE SKILLS.

This set of skills includes the child's ability to understand and evaluate messages of others.

	Home	School	Community
A. Listens effectively to spoken messages (e.g., hears the speaker, understands meaning, follows sequence of ideas and draws inferences).	<p>Clearly repeats a set of instructions given by primary caregiver.</p> <p>Retells an anecdote previously told by another family member.</p>	<p>Recounts the plot of a television program to classmates who have not seen it.</p> <p>Summarizes the main ideas of a report (e.g., history, science, social studies) when given by a classmate.</p>	<p>Accurately summarizes what a friend missed at a recent club meeting.</p> <p>Follows a group leader's instructions for participating in a community activity.</p>
B. Recognizes and interprets nonverbal cues given by others.	<p>Recognizes from facial expressions when a family member is angry or pleased.</p> <p>Recognizes from tone of voice when a family member is exaggerating when telling a story.</p>	<p>Recognizes from facial expressions when the teacher is pleased or displeased.</p> <p>Detects a classmate's sarcasm from tone of voice.</p>	<p>Recognizes and reacts to referee's signals when playing a sport.</p> <p>Recognizes and follows school crossing guard's signals.</p>
C. Describes others' points and recognizes how they differ.	<p>Describes the viewpoint of a family member in a disagreement.</p> <p>Anticipates possible objections when persuading a primary caregiver to purchase a new toy and attempts to address those objections.</p>	<p>Contrasts viewpoints of two different characters in a play seen by the class.</p> <p>In a class debate, compares opponent's position with own position.</p>	<p>Paraphrases positions of two friends in a dispute.</p> <p>When asked, tells why a friend might object to doing what was requested.</p>
D. Distinguishes between different purposes in communication.	<p>Recognizes when a primary caregiver's question (e.g., "Have you brushed your teeth yet?") is really a prompt to act.</p> <p>Differentiates between a television commercial, news broadcast, and entertainment program.</p>	<p>Uses different forms of support when giving an informative talk and a persuasive talk in class.</p> <p>Recognizes that some teacher questions seek to test the student's knowledge while other questions seek to elicit personal responses and ideas.</p>	<p>Recognizes when being subjected to a persuasive message by a friend.</p> <p>Recognizes difference between a radio public service announcement and a commercial.</p>

	Home	School	Community
E. Provides effective and appropriate feedback.	Asks primary caregiver questions concerning reasons for a family rule. Shows a positive reaction when a sibling tells of an accomplishment.	Seeks help from the teacher when having difficulty completing an assignment. Asks questions of a speaker when seeking further information about the topic discussed.	Asks a salesperson for help in finding a product in a store. When following a friend's instructions for constructing or assembling an object, asks questions to clarify procedures.
F. Critically evaluates a spoken message.	Answers and explains riddles with other family members. Detects different moods of a family member when engaging in conversation.	Participates in a brainstorming session on ways to resist pressure to use drugs. Detects propaganda devices (e.g., name-calling, bandwagon, testimonial by famous people) in student government campaign speeches.	Resists a friend's appeal to do something believed to be wrong. Suggests alternative or compromise solutions in mediating a dispute between two friends from different cultures.

Appendix A-3
SCA Competencies—High School Education

SOURCE: These speaking and listening competencies for high school graduates were developed by the Speech Communication Association.¹

I. COMMUNICATION CODES.

This set of skills deals with minimal abilities in speaking and understanding spoken English and using nonverbal signs (e.g., gestures and facial expressions).

	Occupational Application	Civic Application	Daily Application
A. Listen effectively to spoken English.	<p>Understand directions given by others.</p> <p>Understand complaints and needs of others.</p> <p>Understand suggestions and questions of co-workers.</p>	<p>Understand voting procedures given on TV or radio.</p> <p>Understand directions to a jury from a judge.</p> <p>Understand directions given by a police officer.</p>	<p>Understand weather bulletins broadcast on TV.</p> <p>Understand directions for taking a prescribed medication.</p> <p>Understand a plumber's suggestions for preventative household maintenance.</p>
B. Use words, pronunciation, and grammar appropriate for situation.	<p>Use appropriate language during employment interviews.</p> <p>Use pronunciation understood by co-workers.</p> <p>Use grammar understood by co-workers.</p>	<p>Use language understood by members of a culturally diverse group at a civic meeting.</p> <p>Use pronunciation understood by members of a culturally diverse group.</p> <p>Use grammar understood by a culturally diverse group.</p>	<p>Describe an ailment so that a doctor can understand the symptoms.</p> <p>Use language understood by a salesperson when making a complaint.</p> <p>Use language understood when applying for a loan.</p>
C. Use nonverbal signs appropriate for situation.	<p>Use appropriate gestures and eye contact during job-related interviews.</p> <p>Use appropriate facial expressions and tone when conversing with a co-worker.</p> <p>Use gestures which aid a co-worker in learning to perform a work task.</p>	<p>Use appropriate facial expressions and posture at a civic meeting.</p> <p>Use appropriate nonverbal signs when campaigning for a political candidate.</p> <p>Use appropriate nonverbal signs when engaging in political discussions.</p>	<p>Use gestures which enhance a child's understanding of how to perform a household task.</p> <p>Use gestures which enhance a friend's understanding of how to play a game.</p> <p>Use nonverbal signs to indicate sympathy to a friend.</p>

¹ Speech Communication Association (1994). *Speaking and listening competencies*. Annandale, VA: Author.

	Occupational Application	Civic Application	Daily Application
D. Use voice effectively.	<p>Use sufficient volume when making a presentation to a large group in an on-the-job setting.</p> <p>Use appropriate volume when conversing regarding business.</p> <p>Speak with appropriate rate, volume, and clarity when conversing with others.</p>	<p>Speak clearly and loudly enough to be heard in public debate or discussion.</p> <p>Speak with appropriate rate, volume, and clarity when expressing your views to an elected official.</p> <p>Speak clearly and loudly enough to be understood in court.</p>	<p>Speak with appropriate rate and volume in a social conversation.</p> <p>Speak with appropriate rate and volume when reporting to the 911 operator.</p> <p>Speak with appropriate rate and volume when soliciting funds for a charity.</p>

II. ORAL MESSAGE EVALUATION.

This set of skills involves the issue of standards of appraisal to make judgments about oral messages or their side effects.

	Occupational Application	Civic Application	Daily Application
A. Identify main ideas in messages.	<p>Identify the task to be performed when giving instructions orally.</p> <p>Recognize performance standards for work assigned orally.</p> <p>Recognize commitments from promises, threats, and commands.</p>	<p>Select main ideas when listening to political speeches.</p> <p>Identify key points in broadcast interviews with political candidates.</p> <p>Identify critical issues in trial testimony.</p>	<p>Identify main ideas concerning an emergency weather broadcast.</p> <p>Identify main ideas in a broadcast about tax return preparation.</p> <p>Identify main ideas in a purchase contract agreement.</p>
B. Distinguish facts from opinions.	<p>Obtain facts about employment opportunities.</p> <p>Distinguish between facts and opinions in work-related complaints.</p> <p>Distinguish between facts and opinions in work-related disputes.</p>	<p>Distinguish between facts and opinions in political speeches.</p> <p>Distinguish between evidence and opinion in courtroom testimony.</p> <p>Distinguish fact from opinion in newscasts.</p>	<p>Distinguish facts from opinions in television advertising.</p> <p>Distinguish facts from opinions with respect to illness treatment.</p> <p>Distinguish facts from opinions regarding nutrition.</p>

	Occupational Application	Civic Application	Daily Application
C. Distinguish between informative and persuasive messages.	<p>Distinguish between informative and persuasive messages in a work-related interview.</p> <p>Distinguish between informative and persuasive messages from a union organizer.</p> <p>Distinguish between informative and persuasive messages of employees or management.</p>	<p>Identify when being subjected to propaganda.</p> <p>Distinguish between informative and persuasive messages of politicians.</p> <p>Distinguish between informative and persuasive messages of trial attorneys.</p>	<p>Identify when being subjected to a persuasive sales presentation.</p> <p>Distinguish between informative and persuasive messages about purchasing on credit.</p> <p>Distinguish between informative and persuasive messages about use of nonprescription drugs.</p>
D. Recognize when another does not understand your message.	<p>Recognize lack of understanding by other employees.</p> <p>Recognize when a job interviewer doesn't understand your explanation of your work experience.</p> <p>Recognize when a co-worker doesn't understand your directions.</p>	<p>Recognize when another doesn't understand your position on a public issue.</p> <p>Recognize when a public official doesn't understand your request.</p> <p>Recognize when a judge doesn't understand your testimony.</p>	<p>Recognize when another family member doesn't understand your instructions.</p> <p>Recognize when a doctor doesn't understand your description of your illness.</p> <p>Recognize when a salesperson doesn't understand your request.</p>

III. BASIC SPEECH COMMUNICATION SKILLS.

This set of skills deals with the process of selecting message elements and arranging them to produce spoken messages.

	Occupational Application	Civic Application	Daily Application
A. Express ideas clearly and concisely.	Makes a report to the other employees. Explain job requirements to a new employee. State clearly relevant information about your work experience when applying for a job.	Describe a desired course of political action. Describe an accident or a crime to a police officer. Explain First Amendment free speech rights to another person.	Explain an appliance malfunction to a repairperson. Explain an unfamiliar task to a child. Explain your values to a person from another culture.
B. Express and defend with evidence your point of view.	Express and defend your view in a work-related meeting. Express and defend your suggestions for changes in job conditions. Express and defend your reasons for job absence.	Express and defend your view in a political discussion. Express and defend your innocence in court. Express and defend your position in a city council meeting.	Express and defend your refusal to accept products or services you didn't order. Express and defend your beliefs or religion. Express and defend your feelings in a family discussion.
C. Organize (order) messages so that others can understand them.	Use a chronological order to explain a complex procedure to a co-worker. Use a topical order when explaining job performance problems to a co-worker. Use a problem-cause-solution order when making a suggestion to a co-worker.	Use a topical order to explain your political views. Use a cause-effect order when giving an accident report in a courtroom. Use a chronological order to explain a complaint to an elected official.	Use a problem-cause-solution order to explain your reason for applying for a loan. Explain how to prevent accidents using a cause-effect order. Use a chronological order to explain to a mechanic the development of an automobile malfunction.

	Occupational Application	Civic Application	Daily Application
D. Ask questions to obtain information.	<p>Obtain information about correct job performance patterns.</p> <p>Obtain information about job benefits.</p> <p>Obtain information about how to improve your job performance.</p>	<p>Obtain information from public officials about laws and regulations.</p> <p>Obtain information about another's evidence on a political issue.</p> <p>Obtain information about a political candidate's views.</p>	<p>Obtain information about interest rates for purchases bought on credit.</p> <p>Obtain information about your credit rating.</p> <p>Obtain information about another person's cultural beliefs.</p>
E. Answer questions effectively	<p>Answer a potential employer's questions about your qualifications.</p> <p>Answer a co-worker's questions.</p> <p>Answer questions about your job performance.</p>	<p>Answer questions about your position on public issues.</p> <p>Answer questions of a census taker.</p> <p>Answer questions as a witness.</p>	<p>Answer a doctor's questions about an illness you have.</p> <p>Answer a tax auditor's questions.</p> <p>Answer a child's questions so that the child understands.</p>
F. Give concise and accurate directions.	<p>Direct co-workers in performing unfamiliar jobs.</p> <p>Give directions about a job-related task.</p> <p>Instruct others about improving job performance.</p>	<p>Give directions to another about the procedures necessary to vote.</p> <p>Give directions to another about the procedures necessary to file a basic tax return.</p> <p>Give directions to another about the procedures necessary to appear before the city council.</p>	<p>Teach a friend how to play a card game.</p> <p>Instruct repairpersons on how you want some repair made.</p> <p>Teach a child what to do in case of fire.</p>

	Occupational Application	Civic Application	Daily Application
G. Summarize messages.	<p>Summarize oral instructions given by a co-worker.</p> <p>Give a summary of a work-related conference to co-workers.</p> <p>Summarize your qualifications in a job interview.</p>	<p>Summarize the position of a political candidate on a campaign issue.</p> <p>Summarize the arguments for and against a controversial civic issue.</p> <p>Summarize for another the laws/regulations pertaining to some zoning action.</p>	<p>Summarize a radio public service message on auto safety.</p> <p>Summarize a recent telephone conversation for a family member.</p> <p>Summarize the view of a person from another culture about that culture.</p>

IV. HUMAN RELATIONS.

This set of skill is used for building and maintaining personal relationships and for resolving conflict.

	Occupational Application	Civic Application	Daily Application
A. Describe another's viewpoint.	<p>Describe the viewpoint of a co-worker who disagrees with your evaluation of the person's performance.</p> <p>Describe the viewpoint of a co-worker who disagrees with your recommendations.</p> <p>Describe your viewpoint as part of a work-related dispute.</p>	<p>Describe the viewpoint of a friend with whom you disagree about public issues.</p> <p>Describe the viewpoint of a legislator who proposes a law you oppose.</p> <p>Describe the viewpoint of a jury member with whom you disagree.</p>	<p>Describe the viewpoint of a person who wants you to address a controversial view.</p> <p>Describe the viewpoint of a friend when you disagree on a major decision.</p> <p>Describe the viewpoint of a teacher who complains about a student's study habits.</p>
B. Describe differences in opinion.	<p>Describe differences in opinion with co-workers about work related issues.</p> <p>Describe differences in opinion with co-workers about the steps necessary to accomplish a goal.</p> <p>Describe differences in opinion with co-workers about product performance.</p>	<p>Describe differences in opinion with a legislator about proposed legislation.</p> <p>Describe differences in opinion with other jurors.</p> <p>Describe differences in opinion in a zoning hearing.</p>	<p>Describe differences in opinion about cultural practices.</p> <p>Describe differences in opinion with your doctor regarding health care.</p> <p>Describe differences in opinion about the responsibility for household chores.</p>

	Occupational Application	Civic Application	Daily Application
C. Express feelings to others.	<p>Express personal reactions to changes in your job condition.</p> <p>Express satisfaction to a co-worker about his/her work.</p> <p>Express feelings of dissatisfaction with co-workers regarding the quality of work interactions.</p>	<p>Express feelings of anger to your legislative representative.</p> <p>Express your positive reactions about an elected official's work.</p> <p>Express feelings of concern regarding a legislator's voting record.</p>	<p>Express dissatisfaction to a store clerk.</p> <p>Express feelings of approval for a friend's athletic achievement.</p> <p>Express feelings of sympathy to a friend whose parent has died.</p>
D. Perform social rituals.	<p>Introduce yourself at the beginning of a job interview.</p> <p>Greet customers and/or clients.</p> <p>Conclude a conversation with a co-worker.</p>	<p>Introduce a motion at a public meeting.</p> <p>Request an appointment with an elected official.</p> <p>Introduce a speaker at a political rally.</p>	<p>Make small talk in casual social settings.</p> <p>Introduce strangers to one another.</p> <p>Introduce yourself to another person.</p>

Appendix A-4
Sample Listening Test

Statewide samples of fourth, seventh, and tenth grade students were administered a listening test in Michigan in 1979 (Michigan Education Assessment Program, 1979–80). The tests contained three multiple-choice questions for each of the following skills.

Skills Areas	
Identify main idea	Identify best summary
Identify purpose	Recall information
Identify cause and effect relationships	Infer character traits
Identify difference between fact and opinion	Identify sequence

Audio taped stories were read to students and the questions about them were read on tape and printed in test booklets for students to answer. Student achievement was high; 79, 71, and 82 percent of the fourth, seventh, and tenth graders, respectively, attained at least six of the objectives.

A sample item from the seventh grade test is given below.

21. Which of these is a fact?
- A. The Amish people never have any fun.
 - B. It is evil for people to carry guns or fight.
 - C. The Amish came to gain religious freedom.
 - D. Advanced schooling is dangerous for the Amish people.

Appendix A-5
Sample Speaking Test

The speaking skills listed below are measured by the Communication Competency Assessment Instrument-High School Edition (CCAI-HS) for students in grades 9–12. The test was developed by R. B. Rubin (Rubin, Welch, and Buerkel, 1996). The skills are based on the SCA competencies for high school graduates.

In the first part of the test, students are asked to give a 3-minute talk. They are given 10 minutes to choose a topic from a list of 38 provided to them or to select one of their own and to prepare notes, if desired, on what they will say. Students then give their speeches and respond in one-to-one interviews of about 15 minutes duration with a trained rater about their high school experiences.

CCAI-HS Speaking Skills	
Use of understandable pronunciation	Appropriate tone of voice
Clarity	Distinguishing between informative and persuasive messages
Presenting thesis and main points clearly and concisely	Expressing and defending a point of view
Recognizing when others do not understand	Introducing yourself appropriately
Obtaining information about a career	Answering instructor's question about classroom performance
Expressing satisfaction or dissatisfaction to an instructor about a course	Using chronological order to explain your activities throughout the day
Giving directions	Describing the viewpoint of a fellow student who disagrees with your evaluation of a class
Describing differences in opinion about steps necessary to accomplish academic or vocational goals	

Appendix A-6
Criteria for the Assessment of Oral Skills

Source: Speech Communication Association, 1993

General Criteria

1. Assessment of oral communication should view competence in oral communication as a gestalt of several interacting dimensions. At a minimum, all assessments of oral communication should include an assessment of knowledge (understanding of the communication process, comprehension of the elements, rules and dynamics of a communication event, awareness of what is appropriate in a communication situation), an assessment of skills (the possession of a repertoire of skills and the actual performance of skills), and an evaluation of the individual's attitude toward communication (e.g., value placed on oral communication, apprehension, reticence, willingness to communicate, readiness to communicate).
2. Because oral communication is an interactive and social process, assessment should consider the judgment of a trained assessor as well as the impressions of others involved in the communication act (audience, interviewer, other group members, conversant), and may include the self report of the individual being assessed.
3. Assessment of oral communication should clearly distinguish speaking and listening from reading and writing. While some parts of the assessment process may include reading and writing, a major portion of the assessment of oral communication should require speaking and listening. Directions from the assessor and responses by the individual being assessed should be in the oral/aural mode.
4. Assessment of oral communication should be sensitive to the effects of relevant physical and psychological disabilities on the assessment of competence. (e.g., with appropriate aids in signal reception, a hearing impaired person can be a competent empathetic listener.)
5. Assessment of oral communication should be based in part on atomistic/analytic data collected and on a holistic impression.

Criteria for the Content of Assessment

1. Assessment of oral communication for all students should include assessment of both verbal and nonverbal aspects of communication and should consider competence in more than one communication setting. As a minimum assessment should occur in the one-to-many setting (e.g., public speaking, practical small group discussion) and in the one-to-one setting (e.g., interviews, interpersonal relations).
2. Assessment of speech majors and other oral communication specialists could include, in addition, assessment in specialized fields appropriate to the course of study followed or the specialty of the person being assessed.

Criteria for Assessment Instruments

1. The method of assessment should be consistent with the dimension of oral communication being assessed. While knowledge and attitude may be assessed in part through paper and pencil instruments, speaking and listening skills must be assessed through actual performance in social settings (speaking before an audience, undergoing an interview, participating in a group discussion etc.) appropriate to the skill(s) being assessed.
2. Instruments for assessing oral communication should describe degrees of competence. Either/or descriptions such as "competent" or "incompetent" should be avoided as should attempts to diagnose reasons why individuals demonstrate or fail to demonstrate particular degrees of competence.
3. Instruments for assessing each dimension of oral communication competence should clearly identify the range of responses which constitute various degrees of competence. Examples of such responses should be provided as anchors.
4. Assessment instruments should have an acceptable level of reliability, e.g. test/retest reliability, split-half reliability, alternate forms reliability, interrater reliability, and internal consistency.
5. Assessment instruments should have appropriate validity: content validity, predictive validity, and concurrent validity.

6. Assessment instruments must meet acceptable standards for freedom from cultural, sexual, ethical, racial, age, and developmental bias.
7. Assessment instruments should be suitable for the developmental level of the individual being assessed.
8. Assessment instruments should be standardized and detailed enough so that individual responses will not be affected by an administrator's skill in administering the procedures.

Criteria for Assessment Procedures and Administration

1. Assessment procedures should protect the rights of those being assessed in the following ways: administration of assessment instruments, assessment, and the uses of assessment results should be kept confidential and be released only to an appropriate institutional office, to the individual assessed, or if a minor, to his or her, parent or legal guardian.
2. Use of competence assessment as a basis for procedural decisions concerning an individual should, when feasible, be based on multiple sources of information, including especially a) direct evidence of actual communication performance in school and/or other contexts, b) results of formal competence assessment, and c) measures of individual attitudes toward communication (e.g., value placed on oral communication, apprehension, reticence, willingness to communicate, and readiness to communicate).
3. Individuals administering assessment procedures for oral communication should have received sufficient training by speech communication professionals to make their assessment reliable. Scoring of some standardized instruments in speaking and listening may require specialized training in oral communication on the part of the assessor.

Criteria for Assessment Frequency

Periodic assessment of oral communication competency should occur annually during the educational career of students. An effective systematic assessment program minimally should occur at educational levels K, 4, 8, 12, 14, and 16. (Speech Communication Association, 1993, pp. 33–35)

**STATEWIDE
ASSESSMENT OF
INFORMATION
LITERACY SKILLS**

**Feasibility Study
November 1997**

STATEWIDE ASSESSMENT OF INFORMATION LITERACY SKILLS

Feasibility Study

Definition of Skills

The assessment of student performance in locating and using information resources is the focus of this section. Information literacy skills involve seeking, locating, and using information from printed materials, the Internet, ERIC, e-mail, and other sources. These skills are defined in the Big Six curriculum (Eisenberg & Berkowitz, 1992), the Sunshine State Standards (1996), and the American Library Association (ALA, 1996) list of standards and indicators. Other sources have reported knowledge and skills related to information literacy but generally are not as detailed as the Big Six curriculum. For this reason, the Sunshine State Standards, ALA standards, and Big Six Curriculum skills list will be the primary references for the definition of information literacy skills.

Sunshine State Standards

The Sunshine State Standards includes information literacy skills standards in language arts that deal with reading and writing. For example, the standards and skills concerned with the location and use of information resources include selecting and using reference materials, electronic software, electronic encyclopedias, indexes, publications, computer catalogs, spreadsheets, databases, and electronic media such as the Internet and information services. Appendix B-1 provides a complete list of the standards that relate directly to information literacy skills.

American Library Association Standards

A separate list of skills to consider along with the Sunshine State Standards originates from the ALA. The ALA began developing information literacy standards for students in 1966. The current version contains three categories: Information Literacy, Independent Learning, and Social Responsibility. Appendix B-2 provides the entire set of ALA standards and skills indicators. Category I contains 3 standards and 13 skill indicators that specify learning outcomes most closely related to the functions of the school library and media programs.

[Categories II and III] “build upon the first so that, taken to the highest levels, the standards and indicators present a profile of the information literate high school graduate: one who has the ability to use information to acquire both core and advanced knowledge and to

become an independent, lifelong learner who contributes responsibly and productively to the learning community” (ALA, 1996, p.1).

The Big Six Skills

Neither the Sunshine State Standards nor the standards formulated by the ALA are given in enough detail to be immediately useful in constructing item specifications and assessment instruments. However, Eisenberg and Berkowitz (1992), Eisenberg, Johnson, and Berkowitz (1996), and Darrow (1996) presented a detailed list of skills embedded in a curriculum entitled *Computer Skills for Information Problem Solving: A Curriculum Based on the Big Six Approach*, by Eisenberg and Berkowitz (1990). Table B-1 shows the major list of skills for the Big Six.

Eisenberg and Johnson’s (1996) report provides the following description of the Big Six information literacy curriculum.

The Big Six is an information literacy curriculum, an information problem-solving process, and a set of skills which provide a strategy for effectively and efficiently meeting information needs. The Big Six Skills approach can be used whenever students are in a situation, academic or personal, which requires information to solve a problem, make a decision or complete a task. This model is transferable to school, personal, and work applications, as well as all content areas and the full range of grade levels. When taught collaboratively with content area teachers in concert with content-area objectives, it serves to ensure that students are information literate. (pp. 7–8)

Table B-1**The Big Six Skills List**

1.	<u>Task Definition</u>	4.	<u>Use of Information</u>
1.1	Define the task (the information problem)	4.1	Engage in the source (read, hear, view, touch)
1.2	Identify information needed in order to complete the task (to solve the information problem)	4.2	Extract relevant information
2.	<u>Information Seeking Strategies</u>	5.	<u>Synthesis</u>
2.1	Brainstorm all possible sources	5.1	Organize information from multiple sources
2.2	Select the best sources	5.2	Present the information
3.	<u>Location and Access</u>	6.	<u>Evaluation</u>
3.1	Locate sources	6.1	Judge the process (efficiency)
3.2	Find information within the source	6.2	Judge the product (effectiveness)

Appendix B-3 provides the entire list of specific skills for each component of the Big Six. Each of the Big Six skills has two components and each component has a number of highly specific skills for students to learn. Examples of specific skills include the following under the first skill area: “1. Task Definition,” skill number 1.1: “Define the task (the information problem)” (Eisenberg and Johnson, 1996, p. 3).

- Use e-mail and on-line discussion groups (e.g., listservs, newsgroups) on the Internet to generate topics and problems and to facilitate cooperative activities among groups of students locally and globally.
- Locate and use appropriate computer resources and technologies available within the school library media center, including those on the library media center's local area network (e.g., on-line catalogs, periodical indexes, full-text sources, multimedia computer stations, CD-ROM stations, on-line terminals, scanners, digital cameras).

The evolution of the definition of information literacy skills seems to correspond with the increasing accessibility to technology. Before 1986 many school librarians did not encourage on-line searching by students because costs might be too high and because it might interfere with

traditional search methods (Tenopir, 1986). Thus, most skills lists contained only hard copy skills.

The Montgomery County Public Schools, Maryland (1980a–d) constructed lists of library skills clusters and criterion-referenced tests for grades 6, 7, 9, and 10. For example, skill clusters at the tenth-grade level included “Understanding about Materials,” “Card Catalog,” “General Reference Skills,” “Dictionaries,” “Atlases,” “Newspapers,” “Periodical Indexes,” “Additional References,” and “Production of Media.” Skills within the Periodical Indexes cluster were: “Use the unabridged *Readers’ Guide* to locate specific articles” and “Decode symbols and abbreviations used in the unabridged *Readers’ Guide*” (1980d, p. vi).

Later the Kentucky State Department of Education, Frankfort (1984) published lists of essential library, research, and reference skills for mastery by K–12 students. The skills were intended to be incorporated into the existing curriculum and taught by both classroom teachers and librarians. Grade 10 skills included the following:

- Identify the information (title of article, magazine, and date of magazine, volume, page numbers) in a magazine index entry (e.g., *Readers’ Guide*).
- Select the most appropriate research sources (e.g., newspapers, magazines, audiovisual materials, reference books, and interviews) for a specific topic. (p. 17)

It should be noted, however, that as early as 1976 high school students in Montgomery County and in a number of other states were using DIALOG in addition to hard copy resources to search for information (Tenopir, 1986). Much of the more recent work has identified information literacy skills that relate to the Big Six list. Some sources have reported a more limited range of skills or lists that are not as detailed as the Big Six list as illustrated in the following studies.

- Kuhlthau (1985) developed a two-dimensional model for library skills instruction. Six stages of the library research process were identified (receive assignment, select topic, explore for focus, form focus, collect information, and prepare to present) and crossed with student feelings, thoughts, and actions. This model is applicable to instruction for both hard copy and electronic skills.
- Craver (1985) taught four groups of college-bound high school students ($n=67$) on-line bibliographic searching over a two-year period. Students conducted research in preparation

for 17 debate topics. Examples were capital punishment, genetic engineering, and socialized medicine. The following course objectives were provided for the course (p. 133):

1. Possess a basic understanding of what on-line searching is.
 2. Be cognizant of relevant on-line searching terminology, including Boolean operators, access points, and limiting functions.
 3. Be aware of the variety of available databases and comprehend the selection process.
 4. Have a rudimentary knowledge of the thesaurus and indexes that are used in the preliminary stages of search strategy formulation.
 5. Be able to posit a tentative search strategy in terms of Boolean logic upon directed topics in preparation for actual on-line searching.
 6. Be able to correctly interpret a bibliographic record and evaluate the results received.
 7. Observe the execution of a search strategy on a selected database.
 8. Utilize some of the citations as research for debate topics.
 9. Be knowledgeable regarding the advantages and disadvantages of on-line searching.
- Doyle (1992) provided a summary of a Delphi study for the National Forum on Information Literacy to define information literacy and to describe an information literate person. “Information literacy is the ability to access, evaluate, and use information from a variety of sources” (p. 2).

An information literate person is one who

1. Recognizes the need for information.
2. Recognizes that accurate and complete information is the basis for intelligent decision making.
3. Formulates questions based on information needs.
4. Identifies potential sources of information.
5. Accesses sources of information including computer-based and other technologies.
6. Evaluates information.
7. Organizes information for practical application.
8. Integrates new information into an existing body of knowledge.
9. Uses information in critical thinking and problem solving.

- Five information literacy standards were constructed for students in Colorado by the Colorado Educational Media Association and the Colorado State Department of Education, Denver, State Library and Adult Education Office (1994a, 1994b). Students are expected to accomplish the following standards, each of which contains a number of component skills (1994b, p. 1).

Construct meaning from information.

Create a quality product.

Learn independently.

Participate effectively as a group member.

Use information and information technologies responsibly and ethically.

Review of Assessment Strategies

Measures of information literacy skills have included on-line electronic research projects, search strategy assignments, and written tests. Formats have included multiple-choice tests, written reports, electronic portfolios, and transaction logs.

Assessment Instruments

Models for assessment and a variety of tests have been developed to assess information literacy skills. Like the skills lists themselves, assessment instruments vary in comprehensiveness and format. The following information provides a review of assessment instruments designed to measure information literacy skills. Sample items from some of these assessment instruments appear in Appendix B-4.

- The Florida Comprehensive Assessment Test ([FCAT], Florida Department of Education, 1997a-i) series includes tests of reading skills that will require students to read and analyze extensive reading passages as opposed to more traditional brief paragraph selections. However, FCAT does not at this time include an assessment of the information literacy skills that are above and beyond analysis of reading passages.
- The Educational Testing Service (1990) compiled an annotated list of 45 tests of library skills. Eleven of them measure only library skills; the remainder incorporate library skills in a general achievement measure (reading, math, social studies, etc.). For all tests, all or most items are in multiple-choice format and are measures of hard copy skills. Reliability and validity data for the 11 library skills tests were unavailable in this review.

- Hyland (1978) developed a library/media test for students in grades 4–12. She constructed a table of specifications based on about 60 state and national elementary, secondary, and college curriculum guides in library/media skills. Items were written for 5 broad skill categories in proportion to the number of skills in these same categories in the table of specifications. The categories were organization, selection, utilization, comprehension, and production.
- The Montgomery County Public Schools, Maryland (1980a–d) produced criterion-referenced library skills tests for grades 6, 7, 9, and 10. The items for grades 7, 9, and 10 are contained in separate test booklets and are accompanied by illustration booklets necessary for answering the items. For grade 6, test booklets for each skill cluster are provided. The number of items for grades 6, 7, 9, and 10 are 182, 116, 98, and 82, respectively. Items for all grades are multiple choice and all measure only hard copy skills.
- Craver (1985) reported on a test administered to students at the end of a two-year course of study. Test sections included (1) Terminology, (2) Selection of Appropriate Databases, (3) Search Strategy Formulation, (4) Citation Interpretation, and (5) Disadvantages and Advantages of On-line Searching. Appendix B-5 provides a copy of the entire test.
- Doyle (1992) suggested that the attributes of an information literate person could be used as rubrics for a checklist of information literacy skills.
- Grover (1994) developed a model for assessing information skills instruction based on the Big Six model. He suggested assessment techniques for each of the Big Six skills that could be used by teachers and library media specialists to evaluate both individual students and classroom groups.
- McKenzie (1994) provided two research questions that could assess many of the Sunshine State Standards and the Big Six skills. Both research questions require the use of the Internet to locate information to assist in decision making. The first research question relates to a real-world environmental problem; the second concerns an everyday personal-life problem. Appendix B-4 includes the full statement of each of these research questions.
- Liebscher and Marchionini (1988) reported an experiment in which 26 ninth-grade science students of average ability were randomly assigned to one of two search strategy training groups. The *Grolier Electronic Encyclopedia* was the full-text CD-ROM database employed

in the study. Students in one group were taught a simple browse strategy while those in another group were taught a more complex Boolean strategy. The study was carried out during 26 half-hour sessions over a three-week period. The dependent variables were “captured keystrokes to examine retrieval performance” and written reports. While no statistically significant differences were observed for either variable, the browse strategy group of students tended to use fewer search terms and to retrieve more titles than the Boolean strategy group of students. However, students who had been taught the browse strategy retrieved fewer relevant titles than those who had been taught the Boolean strategy. The sample search questions appear at the end of Appendix B-4.

- Lankes (1995) reported on the use of electronic portfolios. If student information literacy skills were assessed through research projects such as those mentioned above, electronic portfolios might facilitate data gathering and analysis.

. . . current technology allows for the capture and storage of information in the form of text, graphics, sound, and video, students can save writing samples, solutions to mathematics problems, samples of art works, science projects and multimedia presentations in one coherent document. (p. 2)

Lankes mentioned one computer program (Grady, 1991) designed specifically for portfolio production and two others—Hyperstudio (Wagner, 1993) and Filemaker Pro (Brewer, 1994)—that allow teachers to create their own portfolio programs.

- Four studies reported the use of transaction logs in evaluating the use of on-line catalogs by college library patrons (Ballard, 1994; Ensor, 1992; Hancock-Beaulieu, Robertson, & Neilson, 1991; Schuck, 1992). Transaction logs are computer records of the searches made on the electronic catalog. One logging system was reported to perform the following functions:
 - (a) maintaining complete screen logs, with timing information;
 - (b) playback of logs, in a simulation of real time;
 - (c) printout of logs as displayed;
 - (d) summarization and printout of logs;
 - (e) pre- and post-search on-line questionnaires;
 - (f) in-search questionnaires.

(Hancock-Beaulieu et al., 1991, p. 524)

Transaction logs could be a valuable source of information about the information literacy skills of students in Florida, but public schools do not presently have the capability to produce them (Ulm, 1997).

Validity

Validity evidence for currently existing measures of literacy skills is limited. For example, no information on validity was reported for the 11 library skills tests compiled by the Educational Testing Service (1990). For some instruments, validity of the defined domain of information literacy skills has been approached by developing criterion-referenced tests and using Delphi techniques and expert reviews. In one study, a panel of 68 qualified professionals assessed the content validity of the instrument which was then pilot tested on 135 students (Hyland, 1978). Following analysis and revision of the test, it was administered to 2,670 students in rural, suburban, and urban settings in Ohio. In a third study, Craver (1985) found that 98 percent of the students had scores in excess of 80 percent on a posttest for on-line bibliographic searching skills.

Another issue related to the domain of information literacy is the tendency to define information literacy as problem solving. The relationship of problem-solving skills to information literacy skills is clear. The third section of this report explains this relationship. It compares information literacy skills to problem-solving skills for the purpose of planning a statewide assessment of skills in both domains.

Reliability

Reliability studies for information literacy skills are limited. For example, no reliability information was reported for the 11 library skills tests compiled by the Educational Testing Service (1990). However, Hyland (1978) reported internal reliability coefficients ranging from .85 to .89 for the total library/media test of 53 items for grades 4–12. Both total and category means increased with grade level.

Possible Design for Assessment

The construction of any of the assessment items for information literacy requires clarity of the relationship to problem-solving skills. Many problem-solving tasks require information literacy skills, and information literacy tasks require problem solving. Information literacy is like problem solving because it applies across many other domains. It is like academic skills areas

such as math and science because it includes areas of specialized knowledge. The demonstration of information literacy skills requires tasks *related* and *unrelated* to problem solving. The relationship to problem-solving skills is explored fully in the third section of this report on the feasibility of a statewide assessment of problem-solving skills.

Three assessment modules, each based on a different test format, are proposed. The first would contain multiple-choice and constructed-response items based on the Sunshine State Standards and the Big Six skills. The second would contain constructed-response items based on on-line searches by students, and the third would consist of a research report in which students define an information problem, acquire information through multiple source searches, synthesize the information, and report the results. Table B-2 shows the three assessment modules and the measurement format for each module.

Table B-2

Assessment Modules

Assessment Modules	Format
1—Knowledge Test of Sunshine State Standards and Big Six List	Multiple Choice Constructed Response
2—On-line Searches Using Skills from Sunshine State Standards and Big Six List	Constructed Response
3—Information Problem to Be Solved Using Skills from Sunshine State Standards and Big Six List	Research Report with Portfolio Samples

Test Characteristics

The proposed assessment for information literacy skills should address the Sunshine State Standards, the Big Six list, and relevant information from the ALA. It is recommended that samples of students at all three grade levels, such as grades 5, 8, and 10, be administered the multiple-choice test. The other two modules could be given to all three grade levels or to the two upper grade levels.

- All stimulus materials can be print-administered and can be provided on CD-ROM, allowing for individualized computer-administered testing. Print stimulus materials would be available for multiple-choice and constructed-response items. For on-line search and

research reports, the process of generating responses would require the use of a computer system, but the final product may be hard copy print materials and/or electronic files.

- Test items would be constructed to address the Big Six skills, the Sunshine State Standards, and other relevant information such as ALA skills for grades 5, 8, and 10.
- The first assessment module would be a knowledge test that contains multiple-choice and constructed-response items.
- The second assessment module would contain constructed-response items to address on-line searches.
- The third assessment module would consist of a research report in which students define an information problem, acquire information through multiple source searches, synthesize the information, and report the results. Possible activities for each topic require students to (1) record each step of the information search and reasons for each step in a computer or paper notebook; (2) identify and list the available references and electronic resources that contain information related to the topic; (3) use appropriate telecomputing etiquette to participate and record e-mail or on-line discussions; (4) generate a table, graph, or spreadsheet to organize the data related to the topic; and (5) write a final report.
- All multiple-choice items would require answer keys.
- All constructed-response items would require scoring rubrics. Answers for the on-line search questions and the research report would require detailed rubrics and examples for scoring. The print or computer notebook log of steps and reasons would require a separate scoring rubric.
- Administration time would vary for each of the three assessment modules as follows.

Assessment Module 1—about 45 minutes to administer the 30–40 multiple-choice and/or constructed-response items to groups of students.

Assessment Module 2—about one hour for administration of on-line constructed-response items to each group of students, the group size depending on the number of available computer stations at the school site.

Assessment Module 3—about two weeks for each classroom group to develop research reports in the form of portfolios containing records of search strategies, notes, and final reports; total administration time will vary with accessibility of computer stations.

Construction, Administration, and Evaluation

The following activities would be undertaken by project personnel in the construction, administration, and evaluation of each of the instruments.

- **Assemble Committees.** For each grade-level assessment, assemble two committees—development and review. Include on each committee 5 subject-matter experts who are public school teachers and university personnel. The first committee would select skills to be measured from the Sunshine State Standards and Big Six skills lists and would also develop item specifications and items for each skill. The second committee would review the skills, item specifications, and items and recommend any changes to them.
- **Train.** Training for both the development and review committees would include the purpose and format of specifications, item development, readability characteristics of items, ways to avoid bias, and DOE security requirements. The review committee also would receive specific instructions concerning assessment of test materials for clarity, content adherence to specifications, and psychometric properties.
- **Item Development.** Develop and review multiple-choice and constructed-response items. For the search and portfolio assignments, the development committee and project staff would determine the hard copy and electronic specifications. These specifications would include determining use and access to the World Wide Web/Internet and the electronic references to use such as encyclopedias or electronic bookshelf references. The development committee may also determine what other references should be available.
- **CD-ROM Production.** The instructional designer would be responsible for production of the CD-ROM. The review committee would review and approve the CD-ROM prior to the pilot study.
- **Prepare Answer Documents.** Prepare answer documents for multiple-choice/constructed-response tests, on-line tests, and examiner rating forms for research reports. Also prepare rubrics for scoring constructed-response items and research reports.
- **Develop Training and Administrator's Manuals.** Develop training and administrator's manuals and prepare training materials for administrators.

- **Pilot Study.** The pilot study would involve students in 10 classrooms with a minimum of 15 students at each grade level. The selected classrooms should represent at least 5 school districts. Four additional aspects for the pilot test are listed below.
 - 1. Scoring.** The multiple-choice sections would be scored using an answer key. Scoring of constructed-response items and research reports would involve two persons who will score according to developed scoring rubrics. Scoring rubrics for portfolio and research report assignments would include product evaluation guidelines.
 - 2. Reliability.** Project staff would conduct an item analysis of the test items, including use of an appropriate IRT model, and interrater-reliability studies of all constructed-response and research report measures.
 - 3. Validation Meeting.** A subcommittee consisting of members from both the development and review committees would review the results of the pilot test and revise and approve any changes necessary to the test items or other test components.
 - 4. Production.** Project staff would complete final reviews, edit materials, and produce print and electronic/CD-ROM formats of all materials.

Statewide Assessment

Statewide assessment would involve the following activities.

1. For each grade level, select a random sample of 100 schools stratified by region of the state, school size, and school achievement. Within each school, randomly select one classroom containing 25 to 35 students. Middle and high school students should be selected from language arts classes.
2. Obtain permission from selected schools and teachers to administer tests. Develop testing schedule.
3. Produce approximately 3,500 multiple-choice/constructed-response test booklets and answer documents, 3,500 on-line test booklets and answer documents, and 3,500 rating forms for research reports.
4. Deliver test booklets and answer documents for multiple-choice/constructed-response and on-line tests to participating districts.
5. Train district administrators. Complete testing within a two-week time period.
6. Receive completed answer documents and research reports from districts.

7. Select, train, and monitor readers of constructed-response listening items and research reports. Scan multiple-choice items.
8. Produce data files for each grade level. Do item analyses, reliability, and bias studies by grade level.

Potential Costs of Assessment

The following information provides an outline of the timeline, staffing requirements, list of deliverables, and estimated costs associated with the development of the information literacy tests for each of three grade levels, such as grades 5, 8, and 10. The estimated costs reported in this study are limited only to the costs of development and do not include the costs of administration.

The main reason for lack of inclusion of the cost of administration for the information literacy assessment is that there are many variables that can impact the cost of administration. The administration of assessment modules 2 and 3 depend upon accessibility to computer systems and associated technologies at each school site.

The approximate time for the development of the information literacy tests is 12 months. It would require the use of a number of professionals. Table B-3 illustrates a reasonable configuration of the core professional staff required during the development phase. The level of direction, management, psychometric, instructional, computer, editorial, graphic design, and related expertise can be provided through a different staffing pattern but should cover the required areas of expertise at about the level indicated.

Table B-3
Project Staffing

Project Staffing			
Project Director	Half Time	Proofer	Half Time
Project Manager	Full Time	Graphic Designer	Quarter Time
Psychometrician	Full Time	Word Processor	Half Time
Instructional Designer/Programmer	Six Months	Graduate Assistant	Half Time
Information Literacy Specialist with Computer Proficiency	Three Months	Graduate Assistant	Half Time
Editor	Half Time	Assistant Manager	Full Time

In addition to the core project staffing, committee members will meet to accomplish the development and review activities (see Table B-4).

Table B-4
Committee Meetings

Committee Meetings	
Development Committee (15 members)	Five Meetings (9 days)
Review Committee (15 members)	Four Meetings (9 days)

Deliverables. The deliverables for each assessment module are shown in Tables B-5 through B-7.

Table B-5

Deliverables—Assessment Module 1

Deliverables	
Training Manual	Camera-Ready Copy, Electronic Copy, and 50 Hard Copies
Administration Manual	Camera-Ready Copy, Electronic Copy, and 50 Hard Copies
Grade #1 Test (such as fifth grade)	1,000 Copies on CD-ROM and Print Format
Grade #2 Test (such as eighth grade)	1,000 Copies on CD-ROM and Print Format
Grade #3 Test (such as tenth grade)	1,000 Copies on CD-ROM and Print Format
Grade #1 Answer Document	Camera-Ready and Electronic Copies
Grade #2 Answer Document	Camera-Ready and Electronic Copies
Grade #3 Answer Document	Camera-Ready and Electronic Copies
Grade #1 Test, Answer Key, and Rubrics	Camera-Ready and Electronic Copies
Grade #2 Test, Answer Key, and Rubrics	Camera-Ready and Electronic Copies
Grade #3 Test, Answer Key, and Rubrics	Camera-Ready and Electronic Copies

Table B-6**Deliverables—Assessment Module 2**

Deliverables	
Training Manual	Camera-Ready Copy, Electronic Copy, and 50 Hard Copies
Administration Manual	Camera-Ready Copy, Electronic Copy, and 50 Hard Copies
Grade #1 Test (such as fifth grade)	1,000 Copies on CD-ROM and Print Format
Grade #2 Test (such as eighth grade)	1,000 Copies on CD-ROM and Print Format
Grade #3 Test (such as tenth grade)	1,000 Copies on CD-ROM and Print Format
Grade #1 Answer Document	Camera-Ready and Electronic Copies
Grade #2 Answer Document	Camera-Ready and Electronic Copies
Grade #3 Answer Document	Camera-Ready and Electronic Copies
Grade #1 Test, Answer Key, and Rubrics	Camera-Ready and Electronic Copies
Grade #2 Test, Answer Key, and Rubrics	Camera-Ready and Electronic Copies
Grade #3 Test, Answer Key, and Rubrics	Camera-Ready and Electronic Copies

Table B-7
Deliverables—Assessment Module 3

Deliverables	
Training Manual	Camera-Ready Copy, Electronic Copy, and 50 Hard Copies
Administration Manual	Camera-Ready Copy, Electronic Copy, and 50 Hard Copies
Grade #1 Test (such as fifth grade)	1,000 Copies on CD-ROM and Print Format
Grade #2 Test (such as eighth grade)	1,000 Copies on CD-ROM and Print Format
Grade #3 Test (such as tenth grade)	1,000 Copies on CD-ROM and Print Format
Grade #1 Answer Document	Camera-Ready and Electronic Copies
Grade #2 Answer Document	Camera-Ready and Electronic Copies
Grade #3 Answer Document	Camera-Ready and Electronic Copies
Grade #1 Test, Answer Key, and Rubrics	Camera-Ready and Electronic Copies
Grade #2 Test, Answer Key, and Rubrics	Camera-Ready and Electronic Copies
Grade #3 Test, Answer Key, and Rubrics	Camera-Ready and Electronic Copies

Total Cost. The total cost for the development and pilot testing of print and computer administration (CD-ROM) of the information literacy assessment is \$733,000. Table B-8 provides a breakdown of cost by category.

Table B-8

Cost Breakdowns

Breakdown of Cost by Category	
Personnel	\$498,500
Contractual Services	31,300
Travel	111,600
Materials and Supplies	42,500
Printing/Copying	11,000
Communication	14,500
Postage and Shipping	7,300
Equipment Maintenance	5,500
Capital Outlay	10,800
Total	\$733,000

The cost of development and pilot testing of only print administration for information literacy assessment is estimated at \$694,000.

Feasibility Statement

Development and administration of the multiple-choice/constructed-response test is highly feasible from the point of view of cost, ease of administration, and scoring. Test items for this measure would be based on features of electronic catalogs and electronic encyclopedias as well as print media. Because a number of different electronic catalogs and electronic encyclopedias are in use in Florida, it might be difficult to construct items that would be applicable to all systems. Ulm (1997) pointed out that 1,438 school libraries in Florida at present have the capability to access SUNLINK, an electronic catalog that allows Boolean and other forms of searching. There are two formats that students can use to search for information in all schools connected to SUNLINK: CD-ROM and the World Wide Web. The CD-ROM format allows students to request interlibrary loans of material not in their home schools. In addition, an electronic version of the *Encyclopedia Britannica* is available to schools over the FIRN network.

It may be possible to construct items based on these two systems that would be applicable for all students. In addition, probably all electronic catalogs allow Boolean searches, allow browsing, and have similar descriptors.

The on-line and research report assessment modules are feasible from the point of view of cost of development. Limited access to computer stations could present an administrative problem in some schools. Scoring for both modules is feasible, but detailed rubrics would need to be developed, especially for the research report. Barlow, Karnes, and Marchionini (1987) raised an issue that is relevant for scoring research reports. "Plagiarism from written sources such as encyclopedias has always been a concern to educators; however, the ease and speed with which text from these sources can be reproduced and combined with text from other sources now create an entirely new problem" (p. LC71). The rubrics for research reports would need to take into account this source of contamination.

Print materials or CD-ROM may be used to administer the first assessment module. Computer access will be required for administration of the second and third assessment modules. The Florida Office of Information Technology will complete a microcomputing resources survey during the fall of 1997. It is recommended that the results of the microcomputing resources survey be reviewed before information literacy assessment is undertaken. The survey would obtain the following information for each public school in Florida:

- number of each type of microcomputer (e.g., Apple II, Macintosh, Intel 486) used primarily for instruction
- number of students who use microcomputers for computer literacy
- whether the school has a full-scale schoolwide instructional network
- the primary operating system used with the schoolwide network: (1) Novell, (2) Windows NT, (3) AppleShare, (4) Not Applicable
- the number of classrooms, media centers, computer labs, other instructional areas, and administrative areas that (1) do not have Internet access, (2) have at least one Internet connection, or (3) have five or more Internet connections

Results of this survey could help determine the feasibility of development and administration of the on-line and research report assessments. They could also assist in the development of a sampling plan for selecting schools for the statewide assessment.

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STATEWIDE ASSESSMENT OF INFORMATION LITERACY SKILLS

Feasibility Study

Appendices

- Appendix B-1 Sunshine State Standards Related to Information Literacy
- Appendix B-2 American Library Association Standards and Skills Indicators
- Appendix B-3 Big Six Skills List
- Appendix B-4 Sample Items for Information Literacy
- Appendix B-5 Sample Information Literacy Test

Appendix B-1
Sunshine State Standards Related to Information Literacy

Grades 3–5	Grades 6–8	Grades 9–10
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READING

Standard 1: The student uses the reading process effectively.

8 selects and uses a variety of appropriate reference materials, including multiple representations of information, such as maps, charts and photos, to gather information for research projects

Standard 2: The student constructs meaning from a wide range of texts.

6 uses a variety of reference materials, including indexes, magazines, newspapers, and journals, and tools, including card catalogs and computer catalogs, to gather information for research topics
 7 synthesizes and separates collected information into useful components using a variety of techniques, such as source cards, note cards, spreadsheets, and outlines

1 determines the main idea and identifies relevant details, methods of development, and their effectiveness in a variety of types of written material
 4 locates, gathers, analyzes, and evaluates written information for a variety of purposes, including research projects, real-world tasks, and self-improvement

6 selects and uses appropriate study and research skills and tools according to the type of information being gathered or organized, including almanacs, government publications, microfiche, news sources, and information services

7 analyzes the validity and reliability of primary source information and uses the information appropriately
 8 synthesizes information from multiple sources to draw conclusions

WRITING

Standard 1: The student uses writing processes effectively.

2 organizes information using appropriate systems
 4 selects and uses a variety of electronic media, such as the Internet, information services, and desktop publishing software programs, to create, revise, retrieve, and verify information

Standard 2: The student writes to communicate ideas and information effectively.

4 uses electronic technology, including word-processing software and electronic encyclopedias, to create, revise, retrieve, and verify information

4 uses electronic technology including databases and software to gather information and communicate new knowledge

Appendix B-2
American Library Association Standards and Skills Indicators

Category I: Information Literacy

The student who is information literate:

Standard 1: Accesses information efficiently and effectively, as described by the following indicators:

1. recognizes the need for information;
2. recognizes that accurate and comprehensive information is the basis for intelligent decision making;
3. formulates questions based on information needs;
4. identifies a variety of potential sources of information;
5. develops and uses successful strategies for locating information.

Standard 2: Evaluates information critically and competently, as described by the following indicators:

1. determines accuracy, relevance, and comprehensiveness;
2. distinguishes among facts, point of view, and opinion;
3. identifies inaccurate and misleading information;
4. selects information appropriate to the problem or question at hand.

Standard 3: Uses information effectively and creatively, as described by the following indicators:

1. organizes information for practical application;
2. integrates new information into one's own knowledge;
3. applies information in critical thinking and problem solving;
4. produces and communicates information and ideas in appropriate formats.

Category II: Independent Learning

The student who is an independent learner is information literate and:

Standard 4: Pursues information related to personal interests, as described by the following indicators:

1. seeks information related to various dimensions of personal well-being, such as career interests, community involvement, health matters, and recreational pursuits;
2. designs, develops, and evaluates information products and solutions related to personal interests.

Standard 5: Appreciates and enjoys literature and other creative expressions of information, as described by the following indicators:

1. is a competent and self-motivated reader;
2. derives meaning from information presented creatively in a variety of formats;
3. develops creative products in a variety of formats.

Standard 6: Strives for excellence in information seeking and knowledge generation, as described by the following indicators:

1. assesses the quality of the process and products of one's own information seeking;
2. devises strategies for revising, improving, and up-dating self-generated knowledge.

Category III: Social Responsibility

The student who contributes positively to the learning community and to society is information literate and:

Standard 7: Recognizes the importance of information to a democratic society, as described by the following indicators:

1. seeks information from diverse sources, contexts, disciplines, and cultures;
2. respects the principle of equitable access to information.

Standard 8: Practices ethical behavior in regard to information and information technology, as described by the following indicators:

1. respects the principles of intellectual freedom;
2. respects intellectual property rights;
3. uses information technology responsibly.

Standard 9: Participates effectively in groups to pursue and generate information, as described by the following indicators:

1. shares knowledge and information with others;
2. respects others' ideas and backgrounds and acknowledges their contributions;
3. collaborates with others, both in person and through technologies, to identify information problems and to seek their solutions;
4. collaborates with others, both in person and through technologies, to design, develop, and evaluate information products and solutions.

Appendix B-3

Big Six Skills List

COMPUTER SKILLS FOR INFORMATION PROBLEM-SOLVING: A CURRICULUM BASED ON THE BIG SIX SKILLS APPROACH

(Copyright Michael B. Eisenberg, Doug Johnson, & Robert E. Berkowitz, 1996)

- 1. TASK DEFINITION:** The first step in the information problem-solving process is to recognize that an information need exists, to define the problem, and to identify the types and amount of information needed.

In terms of technology, students will be able to:

- A. Use e-mail and on-line discussion groups (e.g., listservs, newsgroups) on the Internet to communicate with teachers regarding assignments, tasks, and information problems.
- B. Use e-mail and on-line discussion groups (e.g., listservs, newsgroups) on the Internet to generate topics and problems and to facilitate cooperative activities among groups of students locally and globally.
- C. Use desktop conferencing, e-mail, and groupware software on local area networks to communicate with teachers regarding assignments, tasks, and information problems.
- D. Use desktop conferencing, e-mail, and groupware software on local area networks to generate topics and problems and to facilitate cooperative activities among groups of students locally.
- E. Use computer brainstorming or idea generating software to define or refine the information problem. This includes developing a research question or perspective on a topic.

- 2. INFORMATION SEEKING STRATEGIES:** Once the information problem has been formulated, the student must consider all possible information sources and develop a plan for searching.

Students will be able to:

- A. Assess the value of various types of electronic resources for data gathering, including databases, CD-ROM resources, commercial and Internet on-line resources, electronic reference works, community and government information electronic resources.
- B. Identify and apply specific criteria for evaluating computerized electronic resources.
- C. Assess the value of e-mail, and on-line discussion groups (e.g., listservs, newsgroups) on the Internet as part of a search of the current literature or in relation to the information task.
- D. Use a computer to generate modifiable flow charts, Gantt charts, time lines, organizational charts, project plans and calendars which will help the student plan and organize complex or group information problem-solving tasks.

- 3. LOCATION AND ACCESS:** After students determine their priorities for information seeking, they must locate information from a variety of resources and access specific information found within individual resources.

Students will be able to:

- A. Locate and use appropriate computer resources and technologies available within the school library media center, including those on the library media center's local area network, (e.g., on-line catalogs, periodical indexes, full-text sources, multimedia computer stations, CD-ROM stations, on-line terminals, scanners, digital cameras).
- B. Locate and use appropriate computer resources and technologies available throughout the school including those available through local area networks (e.g., full-text resources, CD-ROMs, productivity software, scanners, digital cameras).

- C. Locate and use appropriate computer resources and technologies available beyond the school through the Internet (e.g., newsgroups, listservs, WWW sites via Netscape, Lynx or other browsers, gopher, ftp sites, on-line public access library catalogs, commercial databases and on-line services, other community, academic, and government resources).
- D. Know the roles and computer expertise of the people working in the school library media center and elsewhere who might provide information or assistance.
- E. Use electronic reference materials (e.g., electronic encyclopedias, dictionaries, biographical reference sources, atlases, geographic databanks, thesauri, almanacs, fact books) available through local area networks, stand-alone workstations, commercial on-line vendors, or the Internet.
- F. Use the Internet or commercial computer networks to contact experts and help and referral services.
- G. Conduct self-initiated electronic surveys conducted through e-mail, listservs, or newsgroups.
- H. Use organizational systems and tools specific to electronic information sources that assist in finding specific and general information (e.g., indexes, tables of contents, user's instructions and manuals, legends, boldface and italics, graphic clues and icons, cross-references, Boolean logic strategies, time lines, hypertext links, knowledge trees, URLs etc.) including the use of:
 - search tools and commands for stand-alone, CD-ROM, and on-line databases and services (e.g., DIALOG commands, America On-line, UMI, Mead);
 - search tools and commands for searching the Internet (e.g., Yahoo, Lycos, WebCrawler, Veronica, Archie).

<p>4. USE OF INFORMATION: After finding potentially useful resources, students must engage (read, view, listen) the information to determine its relevance and then extract the relevant information.</p>

Students will be able to:

- A. Connect and operate the computer technology needed to access information, and read the guides and manuals associated with such tasks.
- B. View, download, decompress and open documents and programs from Internet sites and archives.
- C. Cut and paste information from an electronic source into a personal document complete with proper citation.
- D. Take notes and outline with a word processor or similar productivity program.
- E. Record electronic sources of information and locations of those sources to properly cite and credit in footnotes, endnotes, and bibliographies.
- F. Use electronic spreadsheets, databases, and statistical software to process and analyze statistical data.
- G. Analyze and filter electronic information in relation to the task, rejecting non-relevant information.

<p>5. SYNTHESIS: Students must organize and communicate the results of the information problem-solving effort.</p>
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Students will be able to:

- A. Classify and group information using a word processor, database, or spreadsheet.
- B. Use word processing and desktop publishing software to create printed documents, applying keyboard skills equivalent to at least twice the rate of handwriting speed.
- C. Create and use computer-generated graphics and art in various print and electronic presentations.
- D. Use electronic spreadsheet software to create original spreadsheets.
- E. Generate charts, tables, and graphs using electronic spreadsheets and other graphing programs.
- F. Use database/file management software to create original databases.
- G. Use presentation software (e.g., PowerPoint, HyperStudio, Aldus Persuasion) to create electronic slide shows and to generate overheads and slides.
- H. Create hypermedia and multimedia productions with digital video and audio.
- I. Create World Wide Web pages and sites using hypertext markup language (HTML).
- J. Use e-mail, ftp, and other telecommunications capabilities to share information, products, and files.
- K. Use specialized computer applications as appropriate for specific tasks, e.g., music composition software, computer assisted drawing and drafting programs, mathematics modeling software.
- L. Properly cite and credit electronic sources of information in footnotes, endnotes, and bibliographies.

6. EVALUATION: Evaluation focuses on how well the final product meets the original task (effectiveness) and the process of how well students carried out the information problem-solving process (efficiency). Students may evaluate their own work and process or be evaluated by others (i.e. classmates, teachers, library media staff, parents).

Students will be able to:

- A. Evaluate electronic presentations in terms of both content and format.
- B. Use spell and grammar checking capabilities of word processing and other software to edit and revise their work.
- C. Apply legal principles and ethical conduct related to information technology related to copyright and plagiarism.
- D. Understand and abide by telecomputing etiquette when using e-mail, newsgroups, listservs and other Internet functions.
- E. Understand and abide by acceptable use policies in relation to use of the Internet and other electronic technologies.
- F. Use e-mail, and on-line discussion groups (e.g., listservs, newsgroups) on local area networks and the Internet to communicate with teachers and others regarding their performance on assignments, tasks, and information-problems.
- G. Use desktop conferencing, e-mail, and groupware software on local area networks to communicate with teachers and others regarding student performance on assignments, tasks, and information problems.
- H. Thoughtfully reflect on the use of electronic resources and tools throughout the process.

ADDENDUM: Included here are skills and knowledge related to technology that are not part of the computer and information technology curriculum. These items should be learned in context, i.e., as students are working through various assignments and information problems using technology.

Students will be able to:

- A. Know and use basic computer terminology.
- B. Operate various pieces of hardware and software--particularly operating systems--and be able to handle basic maintenance.
- C. Understand the basics of computer programming. Specific courses in computer programming should be part of the school's curricular offerings.
- D. Understand and articulate the relationship and impact of information technology on careers, society, culture, and their own lives.

Appendix B-4
Sample Items for Information Literacy

Hyland (1978)—library/media test for students in grades 4–12.

5. The Dewey Decimal system is used in school media centers because it:
- A. generally groups biographies with other fiction materials
 - B. generally groups materials on the same subject together
 - C. generally groups magazines with other audio-visual materials
 - D. none of the above

(p. 2)

19. Which of the following should you do first in order to prepare an illustrated speech on a topic you do not know anything about?
- A. make charts and graphs
 - B. outline your topic
 - C. use an encyclopedia
 - D. summarize the main ideas

(p. 7)

Montgomery County Public Schools, Maryland (1979a-d)—criterion-referenced library skills tests for grades 6, 7, 9, and 10.

Grade 6 Skill Cluster: Card Catalog

67. Which of these questions could best be answered by finding an author card in the catalog?
- a) What equipment is needed to play soccer?
 - b) Who wrote *Motors and Engines and How They Work?*
 - c) Who is the author of *The Pony Express?*
 - d) What is the name of a book by Jean George?

(p. 23)

TO ANSWER QUESTIONS 85 THROUGH 89. USE ILLUSTRATION 10: MONTGOMERY COUNTY PUBLIC LIBRARIES CHILDREN'S BOOK CATALOG - TITLE SECTION OF TITLES - AUTHORS.

85. What is the call number of *Creepy Crawly Things, Reptiles and Amphibians?*
- a) J 155.455
 - b) J 507
 - c) J 598.1
 - d) J 841

(p. 27)

Grade 6 Skill Cluster: General Reference Skills

91. Which of these would you use to locate a brief history of Greece?
- a) An abridged dictionary
 - b) A biographical dictionary
 - c) A geographical dictionary
 - d) An unabridged dictionary

(p. 31)

Grade 10 Skill Cluster: Understandings About Materials

4. What is the function of an edition?

- a) Directs attention to the authority of the publisher
- b) Explains the use of special reference books
- c) Provides an explanation of terms used in printing
- d) Identifies the number of copies printed at one time

(p. 3)

Grade 10 Skill Cluster: Card Catalog

TO ANSWER QUESTIONS 15 AND 16, USE ILLUSTRATION 3: CATALOG CARDS

15. What is the purpose of card 1?

- a) To indicate that the library has a book entitled *Political Leaders*
- b) To indicate that books about political leaders will be found in the government reference collection
- c) To direct you from a subject heading that is not used in the card catalog to one that is used
- d) To indicate that the kind of filing arrangement used in the card catalog in the media center is alphabetical

(p. 6)

Grade 10 Skill Cluster: Additional References

75. Which of these characterizes a manual?

- a) Contains a listing of authors and titles in one general alphabet
- b) Provides instruction or other information on a particular subject
- c) Presents a history or outline of progress in a certain field of knowledge
- d) Includes general information about location of magazine articles

(p.19)

McKenzie (1994)—two research questions that could assess many of the Sunshine State Standards and the Big Six skills

Sample Research Question (secondary)

Imagine that you and your partners are consultants hired by the states of Washington and Oregon to recommend new policies to stem the decline of the fish harvests in the region during the past decade. Use the Internet to identify all useful practices already tested around the globe and then determine the applicability of these practices to the particular conditions and needs of the northwest. Create a multimedia report for the two governors sharing specific action recommendations as well as the evidence sustaining your proposals.

Sample Research Question (Elementary)

Imagine that your parents have been given job offers in each of the three following cities: New Orleans, Seattle, and Chicago. Knowing of your access to Internet, they have asked you to help them decide which city will be best for the family to select. Before gathering your information discuss and identify with them criteria for selecting a home city. Create a LinkWay or HyperCard stack showing the strengths and weaknesses of each city on the criteria your family considers important.

(p. 2)

Liebscher and Marchionini (1988)—search question assigned to browse strategy and Boolean strategy groups.

What effect does the Earth's rotation have on the circulation of the earth's atmosphere, its climate, temperature, precipitation, and westerly winds? Who discovered this strange effect? (p. 227)

Appendix B-5
Sample Information Literacy Test

I. Terminology

Directions: Place the letter of the term that corresponds to the correct definition in the space provided.

- | | |
|--------------------------|--|
| A. Controlled vocabulary | _____ an indexing term used to describe the content of a document, i.e., |
| B. Descriptor | _____ a subject heading |
| C. Boolean operators | _____ a one-time search in a database that covers a given time period |
| D. Thesaurus | _____ the process of having the computer execute a search after the searcher has given all instructions and is no longer interacting with the computer |
| E. On-line | _____ the collection of terms that constitutes an authoritative list of descriptors that are assigned to items in the database |
| F. Hits | _____ the logical operators AND, OR, NOT, used to create search logic |
| G. File | _____ use of a terminal that permits the user to interact with the computer |
| H. Off-line | _____ an identification code assigned to user when accessing information on the computer |
| I. Retrospective | _____ the number of records contained in a set, may also be called items or postings |
| J. Password | |

II. Selection of Appropriate Databases (A copy of the list of selected databases printed in the manual was made available for this part of the test.)

Directions: In this part, you are to select the database that will give you the most information about the subject. Write the name of the database you have chosen in the space provided. In some instances, more than one database is possible.

1. You need information about air pollution caused by automobile emissions.

Database: _____

2. Find information about the success of pilot programs involving the counseling of teenage alcoholics. (More than one database is possible.)

Database: _____

3. Locate some scholarly articles about Anne Boleyn, the second wife of Henry VIII.

Database: _____

4. You need to find information about test-tube babies. (More than one database is possible.)

Database: _____

5. Find five newspaper articles that document the assassination attempt upon the life of President Reagan. (More than one database is possible.)

Database: _____

III. Search Strategy Formulation

Directions: Formulate a search strategy for each of the topics given below, using the underlined words as your descriptors. Use logical operators AND and OR in order to effectively combine the terms. Assume that the choice of an appropriate database has already been made.

1. Ed is a student at a culinary institute. He needs some *recipes* for *preparation of noodles*. Specifically, he needs information on *Chinese*, *Italian*, and *Japanese* noodles. Diagram a strategy for him.
2. Mary is enrolled in an education course at the university and is doing a project on bilingualism in Canada. Specifically, she needs information on *bilingual curriculum* or *education* programs in *Montreal*, Canada. Devise a strategy for her.

IV. Citation Interpretation

This is a computer printout of a citation from the ERIC database.

3
AN EJ255876.
AU SMITH, ELSIE.
TI ADOLESCENT SUICIDE: A GROWING PROBLEM FOR THE SCHOOL AND FAMILY.
SO URBAN EDUCATION V16 N3 P279-96 OCT 1981. Oct81.
YR 81.

Directions: List the following part of the citation:

Author: _____

Title of article: _____

Journal title: _____

Volume no.: _____

Page numbers: _____

Month and year: _____

V. Disadvantages and Advantages of On-line Searching

Sue is going to make a class presentation about the recent giant panda born in captivity. She has one week to complete her research.

Directions: List five advantages and/or disadvantages of a giant panda on-line search.

(Craver, 1985, pp. 137-138)

**STATEWIDE
ASSESSMENT OF
PROBLEM-SOLVING
SKILLS**

**Feasibility Study
November 1997**

STATEWIDE ASSESSMENT OF PROBLEM-SOLVING SKILLS

Feasibility Study

Definition of Skills

The assessment of student performance in applying academic skills to solve a variety of complex, real-life problems is the focus of this section. No problem-solving association or organization has been identified as a source for defining problem-solving skills. Rather, in this study, 31 problem-solving task statements (Appendix C-3) directly related to the SCANS thinking skills (Appendix C-4) have been identified through a review of publications. The emerging list of problem-solving tasks are grounded in theoretical frameworks (Bloom, 1956; Piaget, 1964; Gagné, 1985; Briggs & Wager, 1981; Gagné, Briggs, & Wager, 1988) and practical applications. The problem-solving domain includes tasks that are part of the accelerating field of information literacy (Appendix C-7) and includes academic skills from the Sunshine State Standards (Appendices C-1 and C-2).

Sunshine State Standards

The Sunshine State Standards identifies problem-solving skills in many academic skills areas. Some of these standards refer to authentic, complex, or real-life problems. Many of the standards do not use the language of problem solving and refer to knowledge about rather than actual skills, but still may be relevant; for example: “knows that when similar investigations give different results, the scientific challenge is to verify whether the differences are significant by further study” (Sunshine State Standards, Science, How Living Things Interact with Their Environment, 1.7). These types of knowledge-standards often contain essential elements of problem-solving strategies, even though they do not explicitly demand the use of the knowledge to solve problems. Appendix C-1 provides a list of the standards that refer explicitly to real-world or real-life problems. Appendix C-4 provides a list of standards that seem to require problem-solving skills and probably could be applied to real-life problems even though they do not refer explicitly to such problems. Practitioners in the specialized academic areas might identify other standards of this type.

Research-Based Definitions

Research-based definitions emerge from reports on assessment and teaching that have shown how critical-thinking, decision-making, and information literacy skills have been woven

into problem solving. Some reports have provided information on how to teach or test problem-solving skills without ever defining the steps of problem solving. Others have provided broad statements of steps, and some are very detailed. Many reports suggested the values or outcomes of problem solving, but few defined the term *problem*. Mayer's study (as cited in Baird, 1983, p. 6) described the features of a problem by stating that a problem has "givens (current fact, situation, or condition), goals (a different, more valued fact, situation, or condition), and obstacles (difficulties that must be surmounted)." One report provided a glossary of terms for the domain of critical thinking (Kneedler, 1988). This glossary omitted the term problem, but defined many other terms such as *analyze*, *argument*, *bias*, *categorize*, and *cause-and-effect*.

Problem Solving. Various reports have identified recognizing and defining a real problem as part of critical or analytical thinking and problem solving (Appendix C-3). A problem is: "**1 a:** a question raised for inquiry, consideration, or solution **b:** a proposition in mathematics or physics stating something to be done **2 a:** an intricate unsettled question **b:** a source of perplexity, distress, or vexation **c:** difficulty in understanding or accepting <I have a ~ with your saying that> **syn** see MYSTERY." Solve means: "**1:** to find a solution, explanation, or answer for." A solution is "**1 a:** an action or process of solving a problem" (Merriam-Webster, 1993, pp. 929, 1119).

Theorists, researchers, and practitioners have identified problem-solving competencies in publications across four and a half decades, and several enduring frameworks have configured problem-solving tasks in the same order—from simple to complex. These include the taxonomy of educational objectives by Bloom (1956), the conceptual development model by Piaget (1964), and the hierarchy of learning capabilities by Gagné (1985), Briggs and Wager (1981), and Gagné, Briggs, and Wager (1988). In each framework, the complex, higher-level skills require the use of the lower-level capabilities.

Table C-1
Problem Solving

Bloom (1956)

knowledge \Rightarrow comprehension \Rightarrow application \Rightarrow analysis \Rightarrow synthesis \Rightarrow evaluation

Piaget (1964)

concrete operational \Rightarrow formal operational

Gagné (1985), Briggs & Wager (1981), and Gagné, Briggs, & Wager (1988)

discriminations \Rightarrow concepts \Rightarrow rules \Rightarrow higher order rules \Rightarrow problem solving \Rightarrow cognitive strategies

RELATED VARIETIES OF LEARNING: information, attitudes, and motor skills

Bloom (1956) introduced problem solving in the application level as a process that begins AFTER presenting a problem. Piaget's study found problem-solving abilities developing as an individual becomes critical of his or her own reasoning and checks the validity of personal conclusions (Fuller, Karplus, & Lawson, 1977, as cited in Miles, 1985).

Gagné (1985), Briggs and Wager (1981), and Gagné, Briggs, and Wager (1988) presented problem solving as its own category with cognitive strategies as the next level (mental planning, monitoring, control procedures).

Appendix C-3 lists 31 problem-solving tasks identified in 15 other references. These tasks range from the basic task of viewing reality and sensing or recognizing a real problem through the task of solving problems within time limits while rapidly executing necessary subskills. Appendix C-4 organizes the problem-solving tasks into the SCANS Thinking Skills. For example, one of the SCANS thinking skills includes "Decision Making—specifies goals and constraints, generates alternatives, considers risks, and evaluates and chooses best alternative."

The following problem-solving tasks, identified in the references cited with Appendix C-3, seem to fit with the SCANS definition of decision making:

- commit energy/motivation to solve/decide goals; self-talk/confidence, perseverance, flexibility
- use constraints to reduce problem/solution space
- estimate risks/trade-offs, judge/set priorities

- recognize/analyze interpretations/perspectives/emotions/ego motives/power plays/traditions
- select/use internal/external criteria; evaluate/judge
- decide/select/reject; blend value/logic/information; defend

These same tasks, as well as the others listed in Appendices C-3 and C-4, have appeared in other reports as lists, matrices, and steps with various sequences, labels, explanations, or definitions (Baxter, Elder, & Glaser, 1994; Carpenter, 1963, Kurfman & Solomon, 1963, Taba, 1967, Orlandi, 1971, and Ennis, 1962, as cited in Kneedler, 1988; Carpenter & Doig, 1988; Hooper, 1996; McIntosh, 1995; Meyers, 1986). Some programs and assessment reports have proposed or reviewed teaching or assessment methods without defining the problem-solving domain; they have simply provided examples of ways to teach or new approaches to test items (Polson & Jeffries, 1985; Ware, 1985). Others have provided conceptual frameworks to improve assessment of problem-solving skills.

For example, Stiggins and Quellmalz (1987) identified three formats (oral, written, and performance tests) to measure five thinking levels (recall, analysis, comparison, inference, and evaluation). Sugrue (1995) analyzed problem-solving components in three research-based models (Glaser, 1992; Schoenfeld, 1985; and Smith, 1991) and in a three-dimensional typology for generating higher-level test items (Williams & Haladyna, 1982). From this analysis, Sugrue identified three response formats (selection, generation, and explanation) and three domains of content knowledge (principles, procedures, and concepts).

Problem-solving content has included estimation, means-ends analysis, rules of logic, laws of probability, probabilistic reasoning, decision-making models, structured inquiry, cooperative or teamwork skills, leadership direction, proportional and combinatorial reasoning, recognition of correlations or relationships, observation, classification, interpretation or inference from data, hypotheses, design, or conduction of experiments (Bloom, 1956; Carpenter & Doig, 1988; Educational Testing Service, 1987; Florida Department of Education, 1997a, 1997b; Harte & Glover, 1993; Kneedler, 1988; Kroll, Masingila, & Mau, 1992; McIntosh, 1995; Meyers, 1986; O’Neil, 1994). Such strategies are commonly applied in fields of communication, math, and science.

Other constructs that influence problem-solving success are metacognitive (planning and monitoring of one's performance) and motivational (perceived self-efficacy, difficulty, and attraction to the tasks) (Beyer, 1987 & Brown, 1970 as cited in Segal, Chipman, & Glaser, 1985; Costa, 1984 & Whimbey & Lochhead, 1982 as cited in Carpenter & Doig, 1988; Sugrue, 1995; Gagné, Briggs, & Wager, 1988). These constructs reflect individual approaches and attitudes, influence test variability, and may provide diagnostic or remediation information in some programs.

Complex Problem Solving. The definition of complex problem solving has implications for the types of problem situations presented in an assessment instrument. The frameworks presented by Bloom (1956), Gagné (1985), Briggs and Wager (1981), and Gagné, Briggs, and Wager (1988) parallel the dictionary definition (Merriam-Webster, 1993, p. 235): “**1 a** composed of two or more parts: composite . . . **2:** hard to separate, analyze, or solve **3:** of, concerned with, being, or containing complex numbers <a ~ root> < ~ analysis> . . . **syn** . . . COMPLICATED, INTRICATE, INVOLVED, KNOTTY mean having confusingly interrelated parts. COMPLEX suggests the unavoidable result of a necessary combining . . . <a *complex* recipe>. COMPLICATED applies to what offers great difficulty in understanding, solving, or explaining <complicated legal procedures>. INTRICATE suggests such interlacing of parts . . . <an *intricate* web of deceit>. INVOLVED implies extreme complication . . . KNOTTY suggests complication and entanglement . . . <*knotty* ethical questions>.”

Bloom (1956) described the taxonomy of objectives as a hierarchy, with an order from simple to complex, related to an order of difficulty in which problems requiring analysis and synthesis are more difficult than problems requiring comprehension or the ability to apply a principle. Gagné (1985), Briggs and Wager (1981), and Gagné et al. (1988) offered a conceptual differentiation of complexity. In their framework, rule-using requires the use of at least two concepts; problem solving requires the retrieval and combination of simpler rules.

Review of Assessment Strategies

Assessment Instruments

Procedures for developing problem-solving tests tend to follow domain-referenced models. If done well, domain-referenced test construction would lead to competency-based decisions rather than ranking decisions. Most of the innovative approaches to problem-solving assessment have provided ideas of how to teach or assess, but have not provided fully developed instruments. Fully developed instruments tended to include written response rather than hands-on methods of assessment.

The following information provides a review of assessment instruments designed to measure problem-solving skills.

- The Florida Comprehensive Assessment Test ([FCAT], Florida Department of Education, 1997a–f) for mathematics includes assessment of some problem skills. Performance task specification and field-test documents included multiple-choice, gridded-response, short-response, and extended-response items. Some items corresponded to complex problem solving in real-life situations. Of these, some require explanations while others do not, and some items are limited to simple rule-using rather than complex problem solving. In addition, the focus of the mathematics assessment is on the application of mathematics knowledge—as such, its validity for generalizability of problem-solving skills is limited and serves fundamentally as a measure of knowledge of mathematics terms, rules, and principles.
- Kropp and Stoker (1966) constructed items to sample from the hierarchy identified in Bloom's taxonomy. Discussion and results tended to support the continuum of the taxonomy and showed the difficulty of constructing items to parallel a hierarchy of skills.
- Coffman (1988) identified a variety of tests from the 1940s–1970s designed to assess higher-order thinking skills.
- Masters (1986) reported an assessment of analytical thinking (information management, logical thinking, problem solving, and decision making).
- Arter (1987) reported 34 higher-order thinking skills (HOTS) tests and 13 achievement tests. The HOTS instruments covered generalizations, reasoning, critical thinking, means-end problem solving, and Bloom's taxonomy. Achievement tests covered making inferences, and

Bloom's taxonomy applied to academic skill areas, reading interpretation, using information across academic areas, and logical relationships.

- Norris and King (1984) identified 7 critical-thinking tests and one test on appraising observations; Norris (1987a, 1987b) later reported on 12 assessment instruments that cover reasoning, appraising observations, deductive logic, assumption recognition, and critical thinking.
- Carpenter and Doig (1988) identified and reviewed 5 standardized examinations and 6 exams developed by universities and colleges for assessing critical-thinking skills. Most focused on observing and reasoning skills. Some covered additional skills in the problem-solving domain.
- Greenan and McCabe (1989) reported on multiple-choice and open-ended item formats of 29 items and 107 subitems to measure 3 levels of reasoning aptitude.
- Pandey (1990) reported on authentic mathematics assessment tests, used for several years in California to focus on real-life problems and give students an opportunity to think for themselves and to express the mathematical ideas that are consistent with their mathematical development. Tests included open-ended questions (15 minutes each), short investigations (60 to 90 minutes given individually or in groups), multiple-choice questions (2 to 3 minutes each), and a portfolio (with selections of students' work).
- The Pennsylvania Department of Education (1997a, 1997b) assessed real-life problem-solving skills in mathematics and writing.

Assessment materials from Pennsylvania in mathematics and writing are of particular interest. In years past, the mathematics items employed were “multiple-choice and called for short-term recall of specific facts or terminology” (Pennsylvania Department of Education, 1997a, p. 2). The 1997 mathematics assessment included both open-ended tasks and enhanced-multiple choice items. The term *enhanced* refers to the complex of skills and processes that a student must bring to bear in order to answer the item; generally, higher-order thinking skills.

These multiple-choice items were framed within situations that replicate those *in the classroom or real life*; give teachers information about *process as well as product*; that is, they measure the strategies or processes that largely define the “doing” of the discipline; often elicit *actual performance* from a student; integrate process with knowledge in order to assess a

constellation of information rather than a discrete piece (Metropolitan Achievement Tests Seventh Edition, Focus On: Enhanced Multiple-Choice Questions, 1992 as cited in Pennsylvania Department of Education, 1997a, p. 3).

The open-ended tasks were *especially useful for measuring students' problem-solving skills in mathematics* since examinees were asked to show how they arrived at an answer or *what thinking was behind the answer* they gave.

The tasks present real-life situations that require students to solve a problem using math abilities Students must read the task carefully, select the necessary information, devise a method of solution, perform the calculations, enter the response directly on the page on which the task is presented and explain the procedure to support the given response. *This provides insight into the student's knowledge, mathematical abilities and reasoning processes.* (Pennsylvania Department of Education, 1997a, p. 5)

These open-ended items were scored on a continuum of correctness following a defined general rubric that outlined the requirements at each scale point and a more detailed scoring guide for each task.

The Pennsylvania Department of Education (1997b) writing assessment allowed for performance assessment through direct assessment of writing samples. The direct assessment targeted the examinee's ability to "organize ideas in logical and coherent expository prose; structure thought in a recognizable rhetorical pattern; demonstrate fluency and ease in the invention of appropriate syntactical patterns; and identify and employ an appropriate tone and style to match a presumed audience" (p. 3). Categories of writing were defined (narrative/imaginative, informational, persuasive) to clarify the conceptual framework for the writing domain. Assessment papers were "scored by a contractor trained to use the Pennsylvania Writing Assessment Holistic Scoring Guide" (p. 11), using a six-point holistic scoring scale.

The items included specific "prompts," some of which could be considered rules. This approach could be interpreted as a problem-solving assessment. However, the very clear directions about what to include in a writing sample eliminated the need for the examinee to retrieve the rules. Therefore, the test measures concepts and rule applications, but not complex problem solving.

Validity

Of the instruments reviewed in this study, few made any special effort to examine validity or to have a large research base for the instrument. Many reported little or no information of validity, and few provided a domain definition for problem solving. Polson and Jeffries (1985) identified this absence of an explicit characterization of problem-solving processes as a major problem for all the programs they reviewed (p. 428).

Kneedler (1988) provided one of the exceptions including a process model, separate glossary for critical-thinking skills, and a comparative analysis of Bloom's taxonomy. In addition, Arter and Salmon (1987) identified 34 higher-order thinking skills tests, 23 of which reported "some" to "extensive" information on validation (from one activity on validation to extensive validation research).

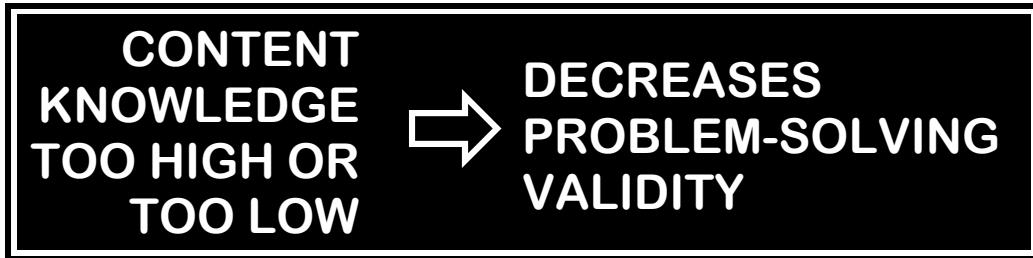
A second validity consideration is the authenticity of measures, an aspect directly related to definition of the domain. Some proponents of authentic measurement have abandoned multiple-choice or constructed-response measures in favor of hands-on laboratory assessments. Yet, for problem-solving tasks, written responses can provide a form of authentic assessment because "they reveal at least in part, what student thinking processes are like" (Meyers, 1986, p. 86).

A third validity consideration is content density of topics in test situations and response alternatives. Meyers (1986) reported "no simple equation between the skills of logic or general problem solving and the practice of critical thinking in specific disciplines" (p. 4). Polson and Jeffries (1985) reviewed four programs with different paradigms. One paradigm is domain-independent, while another assumes that problem-solving skills are too abstract and can only be assessed within a specific content domain. Feurstein, Jensen, Hoffman, and Rand (1985) reported on a content-free program and an assessment in which information must be synthesized in order to extrapolate relationships. Various other reports contained this same mix of paradigms.

Table C-2 illustrates the threat to validity from extremes of very high or very low content knowledge.

Table C-2

Problem-Solving Validity



Generally, as the requirement for recall of prior information increases in a content-rich assessment, the validity of the problem-solving task diminishes. An examinee with high content knowledge tends to use recall rather than the problem-solving process because greater knowledge increases ability to recall prior solutions. While some reports concluded that assessment of problem-solving skills would best be conducted within the fields (Baird, 1983), it is risky to employ test items to which those who have mastery of a subject will know the correct answer. At the same time, the examinee who has low content knowledge of vocabulary and terminology may not understand the task called for in the test item. A valid assessment will balance the content knowledge requirements in order to avoid threats to the problem-solving validity of the measure.

Reliability

Hands-on laboratory measures of problem-solving skills have tended to suffer extreme limits of generalizability due to task sampling variability, and in some instances, difficulty with scoring. In contrast, multiple-choice items can be scored relatively easily and can test a large number of aspects of critical thinking much more effectively than any other form of test (Norris, 1987a, 1987b). One viable approach may be to integrate multiple-choice items with open-ended items and several short investigations (Pandey, 1990; Sugrue, 1995), an approach that provides multiple measures of problem-solving constructs and better task sampling than longer laboratory methods.

The following list of studies shows the variation in the reports of reliability for various problem-solving assessment measures.

- Masters (1986) reported internal consistency reliabilities ranging from .79 at Grade 4 to .86 at Grade 11 for an assessment of analytical thinking.
- Of the 34 higher-order thinking skills tests identified by Arter (1987), 23 reported fair to excellent reliability (at least one reported r of .70 to greater than .80).
- Authentic performance measures of problem-solving tasks have been found to be sensitive to even minor changes in the way a task is presented (Bennet & Ward, 1993; Goldin & McClintock, 1984; Messick, 1993; Millman & Greene, 1989; Snow & Lohman, 1989; Webb & Yausui, 1992—all cited in Sugrue, 1994).
- Linn (1994) reported that “raters are one important source of measurement error” and that “variability due to sampling of tasks is usually greater than that due to raters” (p. 3).
- Shavelson, Baxter, and Pine (1992) and Shavelson, Baxter, and Gao (1993) reported high interrater reliability, but high task-sampling variability for hands-on lab investigations: “person x task interaction was consistently the major source of measurement error accounting for 82%, 49%, and 48% of the total variability for the Science, Math, and CAP-Science data,” respectively (Shavelson, Baxter, & Gao, p. 224).
- Even with systematic design and development procedures, Greenan and McCabe (1989) found that student and teacher ratings of performance “probably are not measuring the same construct as the performance test” for critical-thinking skills (p. 48).
- Baxter, Glaser, and Raghaven (as cited in Baxter, Elder, & Glaser, 1994) reported “a strong positive relationship between performance score and processes of thinking and reasoning” (p. 2), but the meaning of this finding is unclear.
- Sugrue (1995) reported that test items requiring selection and generation responses by examinees yield similar profiles, while those that require explanation are probably a less reliable predictor of problem-solving ability (p. 31).

In earlier research, Bloom (1956) found that students could give more complete reports about their thought processes for problems classified in the more complex classes of intellectual abilities and skills (p. 20). Additionally, “if we do not know the reasons why examinees respond

as they do, then we are not able to justifiably conclude whether their responses are due to good or poor thinking” (Norris, 1987b, p. 23). Sugrue’s (1995) research focused on diagnostic assessment of problem-solving skills by including testing for concepts, metacognitive, and motivational constructs, as well as principles and procedures. Yet Bloom’s earlier findings suggest that reliability of explanation scores may improve simply by limiting them to complex problem-solving situations.

Possible Design for Assessment

Over four decades of research on problem solving show that more valid and instructionally useful information can be gathered through formats that include multiple measures of defined problem-solving tasks across a variety of content areas. These multiple measures include *select*, *generate*, and *explain* response formats (Appendices C-5 and C-6). The assessment of student performance in applying academic skills to solve a variety of complex, real-life problems involves much more than mathematics; problems of a different design would assess problem-solving capabilities that require the application of at least math, science, and social studies and perhaps language arts, reading, and writing in a variety of complex real-life situations.

Norris (1987b) suggested that the FIRST step in designing a test for critical thinking is to define the domain of what is to be tested such as “knowledge and use of a set of *principles* of observational appraisal” (p. 23). According to Sugrue (1995), test specifications for problem-solving tasks should include descriptions of the following factors: (1) tasks, (2) task components, (3) patterns of performance, and (4) theory(ies) of learning and performance involved in the problem-solving domain. Rankin (1987) proposed similar factors: a theoretical framework, the full range of task components, the number of questions, and exercises to measure each skill.

The preceding material in this section addresses these major factors by first reviewing theories of learning and performance involved in problem solving, and then by defining the tasks of problem-solving skills. Although a separate problem-solving glossary also could be developed, the following appendices provide the basic domain description required for designing a problem-solving assessment.

- Appendix C-1: Sunshine State Standards Referencing “Real-World Problems”

- Appendix C-2: Sunshine State Standards with Applications to Real-World Problems
- Appendix C-3: Critical Thinking, Analytical Thinking, and Problem Solving
- Appendix C-4: SCANS Thinking Skills

In addition to these appendices, the context of real-life problems and the stimulus and response formats in Appendix C-5 should guide the sampling across content. Measures should include the major elements of problem-solving skills—principles, procedures, and concepts—and follow sample formats such as the ones in Appendix C-6 to guide the assessment of single and combined skills.

As illustrated in Table C-3, the major categories for response formats are (1) select and explain and (2) generate and explain. Select follows a multiple-choice format, generate follows an open-ended question or performance/hands-on format, and explain follows an open-ended or multiple-choice format. Although presented in serial sequence in Appendix C-5, real-life situations actually demand both simple applications and the simultaneous use of problem-solving skills in different combinations.

The stimulus and response requirements may be assessed through various formats, methods, and media. “A clear conceptualization of the generalizable cognitive constructs to be assessed can be translated into specifications for assessments not only in a variety of content areas, but also in a variety of test formats, from multiple-choice to hands-on” (Baker & Herman, 1983; Messick, 1993; Millman & Greene, 1989; Popham, 1993—all cited in Sugrue, 1994).

Table C-3**Problem-Solving Stimulus and Response Requirements**

		BASIC STIMULUS REQUIREMENTS		
BASIC RESPONSE REQUIREMENTS	Domain of Real-Life—Variety	Domain of Problem Solving—Complex	Content Domains of Academic Skills	
Select	MULTIPLE CHOICE			
Generate	OPEN-ENDED, PERFORMANCE/HANDS-ON			
Explain	MULTIPLE CHOICE OR OPEN-ENDED			
	❖ VARIOUS FORMATS, METHODS, MEDIA ❖			

Measuring Problem-Solving Capabilities. In applying academic skills to solve complex, real-life problems, the task of problem solving focuses on the application of “previously acquired knowledge in solving a wide range of problems involving many different kinds of content” (Segal, Chipman, & Glaser, 1985, p. 34). Problem situations should include questions raised for inquiry, consideration, or solution. These processes are possible only if situations or problems are previously unencountered by the student (Bloom, 1956; Gagné, 1985; Briggs & Wager, 1981; Gagné, Briggs, & Wager, 1988; Sugrue, 1995).

Previously encountered or familiar situations will measure ability other than problem solving; for example, the recall of information about how someone solved the same problem. This novelty requirement presents a challenge in assessing the ability to solve complex real-world problems because an examinee’s life experiences may determine the novelty of any given task. Problem situations may include an intricate unsettled question that requires the use of principles, procedures, or a combination of concepts. Problem situations should require the student to select or generate solutions, answers, and explanations.

The solving of complex problems requires a constellation of behaviors and processes to accurately interpret problems, reorganize relationships, represent and sort problems, create and recognize patterns and causes, form reasonable strategies and plans for action, make decisions, and achieve goals such as finding ways out of difficulty, ways around obstacles, meeting

challenges, or finding answers or solutions to questions (Johnson, 1972; Polson & Jeffries, 1985; Simon, 1980; Belmont, Butterfield, & Ferretti, 1982; Brown, Campione, & Day, 1981; Rigney, 1980; Rowe, 1985; Polya, 1962; Halpern, 1984; Wagner & Sternberg, 1984; Yinger, 1980; Greeno, 1980; Frederiksen, 1984; Laster, 1985—all cited in Laster, 1987; and Chi, 1981; Chi & Glaser, 1985; Glaser et al., 1987; Hardiman, Dufresne, & Mestre, 1989—all cited in Sugrue, 1994).

Problem situations are considered complex only if they require the application of more than one rule or more than three concepts for solution. Problem solving requires that the student “generates, by synthesizing applicable rules” (Gagné, Briggs, & Wager, 1988, p. 289).

In practical terms, the solving of complex problems would require the consideration of multiple variables or factors and their relationships to each other. As noted in Appendix C-5, an assessment item that measures only one concept would not be a sufficient measure, nor would the application of a single rule that measures simple problem solving. The test of one’s ability to use a single rule is an inadequate measure of how one solves a complex problem. Complex problem solving requires retrieval and use of two or more rules, or the creation of an adaptation for a rule by integrating concepts that change its application. Therefore, a simple word problem that requires a student to perform a single operation (multiply, divide, subtract, add, etc.) would not be an adequate assessment of problem-solving capability.

A measure of simple problem-solving abilities, such as the assessment of concepts and rules, would be appropriate only for diagnosis or remediation purposes. If this approach were taken, a separate cluster to assess related concepts and rules could provide the necessary diagnostic information. A separate vocabulary cluster also could provide diagnostic information or serve as a control for variation in specific knowledge of academic domains.

Sample multiple-choice formats in Appendix C-6 illustrate some reasonable approaches for items to assess complex problem-solving skills. For example, Bloom (1956) provided an item for the task of “Given a problem, determine a logical conclusion and judge the logical accuracy of statements in relation to the conclusion” (p. 140). For this task, Bloom presented

- a brief problem situation in two paragraphs
- a set of directions to examine the possible conclusions and determine which one is justified
- a list of the possible conclusions labeled A, B, and C

- another set of directions to review a list of statements and mark in Column A, statements that explain why your conclusion is logical; in Column B, statements that do not explain why your conclusion is logical; and in Column C, statements about which you are unable to decide
- a list of statements, some of which explain each of the given conclusions and some that would not explain them

In another example, Sugrue (1995) offers quite a different format by presenting a situation and circuit illustration in which a student is instructed to predict what will happen to voltage, resistance, and current when other factors are introduced. The question and choices then appear in a matrix format as shown below.

What will happen if you	Voltage	Resistance	Current
add another bulb?	INCREASE	INCREASE	INCREASE
	DECREASE	DECREASE	DECREASE
	NO CHANGE	NO CHANGE	NO CHANGE
add a 9-volt battery?	INCREASE	INCREASE	INCREASE
	DECREASE	DECREASE	DECREASE
	NO CHANGE	NO CHANGE	NO CHANGE
remove one bulb?	INCREASE	INCREASE	INCREASE
	DECREASE	DECREASE	DECREASE
	NO CHANGE	NO CHANGE	NO CHANGE

Appendix C-6 also provides examples of other formats, including constructed-response items for a variety of topics.

The following specific methods have been recommended in assessing problem-solving skills in order to provide more valid and instructionally useful information:

- Use multiple measures of individual problem-solving constructs (Sugrue, 1995). At a minimum, this would require an explanation of the thinking process or principles employed to select or generate an examinee's answer to a problem.

- Provide items with solutions that could be presumed to be not yet encountered at grade level, yet understood without much specialized background (Bransford, Arbitman-Smith, Stein, & Vye, 1985; Feuerstein, Jensen, Hoffman, & Rand, 1985), such as a simple form of complex material that ordinarily comes later (Bloom, 1956).
- Provide a new slant on commonly encountered situations (Bloom, 1956).
- Include a variety of content (Sugrue, 1994) that crosses domains of problem-solving tasks, academic skill content areas, and real-life situations.
- Simplify language; limit vocabulary to appropriate grade level; and/or include a subtest on prerequisite concepts or vocabulary necessary for understanding problem-solving tasks—an examinee's working vocabulary, ability to decode, and basic mathematical operations can be an important part of many problem-solving tasks (Bransford, Arbitman-Smith, Stein, & Vye, 1985; Rankin, 1987).

Sampling Academic Skills Areas. Topics across academic skills in Florida include history, geography, government, economics, science, music, visual arts, theatre, health and physical education, cultural practices and communication, and literature. Greenan and McCabe (1989) identified reasoning, mathematics, communications, and interpersonal relations as the four major generalizable skills that are basic to vocational education programs and necessary for success in vocational occupations. This diversity of domains shows the integration of problem solving in many academic and life areas.

Appendices C-1 and C-2 illustrate the academic skills areas from the Sunshine State Standards that appear to call for problem-solving applications in the following examples.

- From the Appendix C-1 list of standards that refer to real-world problems, Standard 4 in Mathematics states “The student uses estimation in problem solving and computation.”
- From the Appendix C-2 list of standards that seem related, but which do not directly refer to real-world problems, Standard 1 in “How Living Things Interact with Their Environment” states “The student understands the competitive, interdependent, cyclic nature of living things in the environment.”

“Regardless of the format (multiple-choice, open-ended, or hands-on) used to test knowledge structure, a ‘problem-solving’ test should focus on the extent to which the individual’s content knowledge is organized around key concepts and principles that are linked to

application conditions and procedures” (Sugrue, 1994, p. 14). The test should not be testing for knowledge of the academic skill area domain, but should focus on applying previously learned knowledge to complex real-life problems.

The Sunshine State Standards provides guidance for grade-level expectations across academic skill areas. Any other grade-level considerations for problem-solving and information literacy skills would be made by the assessment committee.

Sampling Real-Life Contexts. Real-life areas include daily home life, vocational/work choices and situations, community events and services, and leisure or recreation choices and activities. Assessment of a variety of problems requires representative sampling from different areas of real life.

Adelson (1976) compared problem dimensions for science, humanities, and the world of real life (practical affairs). Table C-4 shows some distinctions related to real-life situations, such as limited time and constraints, use of information and/or group processes, and weighing the risks and trade-offs of actions.

Table C-4
Academic Skills and Real Life

	Science	Humanities	Practical Affairs
Motivation	knowledge of time-invariants, prediction; control of nature	understanding of unique events, guidance re man's relation to cosmos, others, self	wise choice and effective action; making a desirable difference in unique situations
Time Constraint	extended time available to achieve desired degree of confidence and other standards	extended time available to achieve desired standards	limited time available; must do best possible within constraints
Knowledge Criteria	precision, verifiability and explanatory power; stimulus to further research	influence on belief, judgment; consistency with facts; depth of interpretation/implication	utility, relevance, consensus
Modal Setting	university, industry, or government laboratory	university, school	corporation, agency, voluntary association, foundation
Activity Pattern	analysis, hypothesis, experiment	analysis, criticism, hypothesis	analysis, synthesis, redesign, evaluation
Modal Unit	individual	individual	organization/group
Risks	low to moderate	low	moderate to high
Learning Mode	largely sequential	largely sequential	largely collateral

Real life may involve working with teams or groups, working within an organization and systems for how things work, and using complex or collateral learning capabilities. Two other dimensions of real-life demands are accountability and recovery from failure. These distinctions of real-life actions fit well with the type and range of problem-solving tasks in Appendices C-3 and C-4, such as using constraints to define problem space, blending values and logic, and solving problems within time limits.

Examples of real-life problems have included deciding how to vote, planning a route to work, making a grocery list, seeking to understand viewpoints, determining the logic in

conflicting arguments, solving a building problem, figuring the angle on a shot in playing pool, budgeting money, finding a way to retrieve lost keys, adjusting a recipe for different servings, diagnosing a strange noise, choosing the fabric for a school dress, thinking of how to boost sales of a product, developing ways to form friendships, determining the reasons for getting sick from certain foods, determining the cause of someone's hiccups, saving money from baby-sitting, inventing a toy, evaluating ethical behaviors, choosing a hairstyle, planning for the holidays, determining the value of airbags, estimating the use and effects of drugs, writing a newspaper editorial, conducting marketing research, and interpreting a media message (Arter & Paule, 1987; Baird, 1983; Bloom, 1956; de Bono, 1985; Florida Department of Education, 1997a, 1997b; Kneedler, 1988; Lipman, 1985; Thomas, 1987).

Examples of real-life areas that cross academic skills have included accounting, agriculture, art, business, cabinetmaking, child care, communications and interpersonal relations, drafting, history, geography, social studies, information literacy, health, history, home economics, mathematics, music, psychology, literature, reading, reasoning, science, social science, trade and industrial areas, word processing, and writing (Adelson, 1976; Doyle, 1994; Hooper, 1996; Greenan & McCabe, 1989; Educational Testing Service, 1987; Harte & Glover, 1993; Kneedler, 1988; Pennsylvania Department of Education, 1997a, 1997b; Quellmalz, 1987; Wineburg, 1991).

Cross-Referencing Information Literacy. Information literacy is a particular domain of skills that crosses several academic skills areas and problem-solving tasks. The demonstration of information literacy requires tasks related and unrelated to problem solving. It is recommended that the problem-solving assessment include tasks that are unique to problem solving as well as the information literacy tasks that are an essential subset of problem-solving skills. With this approach, the problem-solving assessment would include two parts as shown in Table C-5.

Table C-5**Problem Solving and Information Literacy**

CONTENT DOMAINS	
Problem-Solving Tasks Part 1: Problem Solving	tasks unique to problem solving—not part of information literacy domain
Part 2: Problem Solving and Information Literacy	tasks of problem solving that include essential information literacy tasks
Separate Assessment of Information Literacy Tasks*	tasks unique to information literacy that are not part of problem-solving domain

*In the previous section of this report, three separate assessment modules were proposed for information literacy tasks. These assessment modules would not overlap with the proposed problem-solving assessment.

The following reports have described the relationship of information literacy to problem solving.

- Knowledge acquisition is the first major area of higher cognitive skills—“knowing when you know . . . what you know . . . what you need to know, and . . . the utility of taking active steps to change your state of knowledge” (cf. Brown, 1980, as cited in Segal, Chipman, & Glaser, 1985, p. 67).
- Problems of information-use increase problem-solving failures—failure to observe and use all relevant facts, sloppiness and inaccuracy in collecting and reading information, lack of concern for accuracy (Whimbey and Lochhead, 1980, as cited in Bransford, Arbitman-Smith, Stein, & Vye, 1985).
- Deficient cognitive functions relate to use of information (Feuerstein, Jensen, Hoffman, & Rand, 1985)—blurred and sweeping perception, unsystematic explorative behavior, impaired receptive verbal tools and concepts, deficient need for precision and accuracy, impaired capacity for considering two sources of information at once, dealing with data in piecemeal rather than organized ways, inability to select relevant cues in defining a problem, impaired need for precision and accuracy in communicating one’s response.

- Problem solving requires choices about what information to apply, and locating and using information (Miles, 1985).
- The evaluation of information itself requires the act of utilizing available knowledge (Bransford, Arbitman-Smith, Stein, & Vye, 1985).
- Connected, integrated, coherent, and chunked knowledge improves the ability to solve problems in a particular domain; information must be gathered and organized to analyze a problem, identify relationships, and form a plan (Segal, Chipman, & Glaser, 1985; Sugrue, 1995).
- Critical thinking includes information gathering (Clayton College as cited in Carpenter & Doig, 1988).
- Critical thinking includes dealing with unassessed information, interpretive and reference skills . . . judging information related to problems; critical-thinking skills are practical tools that help students assess and process information (Kneedler, 1988)—form questions that lead to understanding; distinguish verifiable/unverifiable, relevant/nonrelevant, essential/incidental, adequate/inadequate, reliable/unreliable data; determine if facts support generalizations; check consistency of statements/data; use reference skills; and distinguish facts from opinion (Carpenter, 1963; Kurfman & Solomon, 1963; Taba, 1967; Orlandi, 1971; Ennis, 1962—all cited in Kneedler, 1988).
- Critical thinking in real-life music and art problems depends on using key concepts and language in keeping with professional usage (Hooper, 1996).

These same reports also have identified problem-solving skills and deficiencies unrelated to information literacy.

- forming images, creating analogies, seeking out implications (Segal, 1985)
- reasoning on a continuum from a less structured inquiry to a highly structured and formulaic process (Clayton College as cited in Carpenter & Doig, 1988)
- finding the interrelatedness of variables (Miles, 1985)
- solving problems and drawing conclusions; defending and justifying values and viewpoints (Kneedler, 1988)

- failing to spell out relationships fully, to break a problem into its parts, and to represent it in diagrams or other forms; making leaps in logic; lack of perseverance (Whimbey & Lochhead, 1980, as cited in Bransford, Arbitman-Smith, Stein, & Vye, 1985)
- lacking problem-solving skills due to episodic grasp of reality, impaired temporal orientation, impaired conservation of constancies (e.g., size, shape, quantity, orientation), lack of spontaneous comparative behavior, impaired need for summative behavior, difficulties in projecting virtual relationships, lack of orientation toward the need for logical evidence, limited interiorization of one's behavior, impaired planning behavior, and trial and error responses (Feuerstein, Jensen, Hoffman, & Rand, 1985)

Appendix C-7 compares problem-solving tasks to the “Big Six” information literacy tasks (Doyle, 1994; Eisenberg & Berkowitz, 1988; Eisenberg, Johnson, & Berkowitz, 1996). This comparison sorts out the information literacy tasks that do and do not apply to problem-solving processes.

Scoring Protocols. Conscientious efforts should be made to develop scoring protocols that are designed to be equally sensitive to variation in domain-specific knowledge—problem solving, academic skill areas (perhaps including information literacy), and life skill areas. For example, the scoring of a hands-on assessment should not be limited to an evaluation of an outcome; it must also be as sensitive to the differences in an examinee’s problem-solving capabilities, such as the logic applied, as would an enhanced multiple-choice format. Such an approach offers promise for improving reliability; uneven sensitivity produces greater variability (Baxter, Glaser, & Raghaven, 1993; Sugrue, 1994). In other words, careful definition across the domains should serve as the guidepost for development of both assessment items and scoring protocols with equal care. This would mean a performance score and a thinking/explanation score—whether multiple-choice or generated written response, or hands-on. Thinking/explanation scoring would follow from a scoring rubric with defined criteria or a right/wrong answer key.

Test Characteristics

The proposed assessment of problem-solving skills should conform to the assessment design features described in this section. A problem-solving test in two parts will allow a single

score and two subtest scores for comparison with information literacy skills. The recommended division of skills for the two parts appears in Appendix C-7. The problem-solving tests to be used with statewide samples of students in three grade levels, such as 5, 8, and 10, will have the following common characteristics.

- All stimulus materials will be available on CD-ROM, allowing for individualized computer-administered testing. Print stimulus and response materials will be an optional format for the problem-solving assessment.
- Test items for part 1 (problem solving) and part 2 (problem solving and information literacy) will require (1) select and explain and (2) generate and explain responses. *Select* and *generate* responses will indicate the answer (a solution, conclusion, inference, decision, judgment, or plan). *Explain* responses will indicate the reasons for selecting or generating the answer. Use of such multiple measures of problem-solving constructs will provide more valid and instructionally useful information.
- The test items will be carefully constructed to sample the tasks identified in Appendices C-3 and C-7. The problem situations will, at a minimum, sample from the academic areas identified in Appendices C-1 and C-2—math, science, and social studies.
- Tests will sample a variety of complex, real-life problems that require a constellation of intellectual skills known as problem solving. Test situations and response requirements must sample from a variety of content across academic skills and a variety of real-life situations. The academic content of problem situations will focus on the application of previously acquired knowledge in solving a wide range of novel, complex, real-life problems at vocabulary levels appropriate for the grade. Domains of real life include home, community, school, and vocational interests and activities.
- To make situations novel, (1) their content could require solutions, conclusions, inferences, decisions, judgments, or plans that could be presumed to be not yet encountered at the grade level, yet understood without much specialized background, such as a simple form of complex material that ordinarily comes later; or (2) they could present a new slant on commonly encountered situations; or (3) they could require the application of a constellation of procedures, principles, and concepts appropriate for the grade level to a fictitious situation.

- To focus the test on problem-solving capabilities rather than vocabulary, limit the vocabulary to appropriate grade level and purposefully edit to simplify language. As part of development procedures for the test, include a separate subtest to cover vocabulary and specialized terms to assist in sorting out vocabulary and academic content knowledge from problem-solving tasks.
- Problem situations will require a solution, conclusion, inference, decision, judgment, or plan, using the problem-solving tasks identified in Appendices C-3 and C-7. Examples of appropriate problem-solving content include estimation, means-ends analysis, rules of logic, laws of probability, probabilistic reasoning, decision-making models, structured inquiry, cooperative or teamwork skills, leadership direction, proportional and combinatorial reasoning, recognition of correlations or relationships, observation, classification, interpretation or inference from data, hypotheses, design, or conduction of experiments.
- All select responses will be elicited by multiple-choice items. The explain component of the multiple-choice items will include multiple-choice and constructed-response formats—these constructed-response options will be used when multiple-choice options for explain either seem inappropriate or too unwieldy.
- All generate and explain responses will be elicited by constructed short answer formats.
- The presentation of data in problem situations will include a variety of concise forms such as information tables, graphs, data tables, figures, and paragraphs. These will be used to reduce reading time and present information in a concise way. It is very important that problem situations avoid lengthy passages of wordy details so that items do not become too complex or long, causing students to be unable or unwilling to think them through. The sample formats in Appendix C-6 provide some concise approaches for presenting information about complex problem situations.
- All multiple-choice items will require answer keys.
- All constructed-response items will require scoring rubrics. The research report and portfolio assessments will require detailed rubrics and examples for scoring. The notebook or notes log will require a separate scoring rubric.
- The administration time for the problem-solving assessment will be approximately 30 minutes for grade #1 (such as fifth grade) and 45 minutes for grade #2 and grade #3 (such as

eighth and tenth grades), with the expectation that tests will require the application of problem-solving skills using the content knowledge that the students would already possess across the various academic skills identified in the Sunshine State Standards for their respective grade levels.

Construction, Administration, and Evaluation

The following activities will be undertaken by project personnel in the construction, administration, and evaluation of each of the instruments.

- **Assemble Committees.** For each grade level assessment, assemble two committees—development and review. Include on each committee, 10 subject-matter experts consisting of public school teachers and university personnel. Include a sample of students to brainstorm and review the kinds of problems of interest and relevance to students.
- **Draft Items.** The first committee will review and select the skills to be measured from the tasks listed in Appendices C-3 and C-7 and will develop the item specifications. References for this purpose include the Sunshine State Standards identified in Appendices C-1 and C-2, the stimulus and response formats in Appendix C-5, and the sample formats in Appendix C-6. The development committee will develop the item specifications, items, answer keys, and general scoring rubrics—detailed scoring rubrics will be developed later. The development process will incorporate (1) a variety of real-life complex problems that require the application of academic skills and (2) types of problem situations identified by students as being relevant and of interest. In addition, the context of the item will be listed in three parts at the end or below each item: (1) the problem-solving tasks addressed by the item, (2) the academic skills required, and (3) the life-skills area.
- **Review Items.** The review committee will review the draft products and will recommend any changes. This review process will integrate interviews with students to determine if they find the items engaging, how they would respond to the items, why they would respond in particular ways, misleading factors, reading difficulty, and clarity of instructions.
- **CD-ROM Production.** The instructional designer will be responsible for the production of the CD-ROM. The review committee will review and approve the CD-ROM prior to the pilot study. This process will assist in identifying strengths and weaknesses of items and will guide recommendations for changes. Item formats will be examined closely to assure that

students will not be choosing their answers because of capabilities other than problem solving.

- **Training.** Training for the development committee will include the purpose and format of specifications, vocabulary, and readability characteristics for print and computer-administered formats, ways to avoid bias, ways to focus on problem-solving rather than knowledge-testing, and DOE security requirements. Training for the review committee will include how to conduct student interviews, how to assess the clarity of material and its content adherence to specifications, psychometric properties, difficulty, readability requirements, and potential bias.
- **Preparation of Answer Documents.** After review and revision, project staff and the development committee will develop the pilot-test form of the answer keys and detailed scoring rubrics for constructed short answers, the research report, and the portfolio assignments. Both student interviews and critique by committee members should provide assurance that reasonable people would agree on the correct answer to each item.
- **Administration Guidelines.** Project staff will develop administrator manuals and prepare training materials for administrators. The manuals should include specification of the room conditions, equipment requirements, and stimulus and response format options.
- **Pilot Study.** The pilot study will involve students in 10 classrooms at each grade level, with each student completing both parts of the assessment. The pilot study will involve a minimum of 15 students at each grade level and the selected classrooms should represent at least five school districts. Four additional aspects for the pilot test are listed below.
 1. **Scoring.** Scoring of multiple-choice items will be right or wrong. Scoring of constructed-response items will involve two persons scoring according to developed scoring rubrics.
 2. **Reliability.** Project staff will conduct item analysis of test items, including use of an appropriate IRT model, and interrater-reliability studies of all constructed-response measures.
 3. **Validation Meeting.** A subcommittee consisting of members from both the development and review committees will review the results of the pilot test and revise and approve any changes necessary to the test items or other test components.

4. Production. Project staff will complete final reviews and edits of materials. Project staff will produce print and electronic/CD-ROM formats of all materials.

Statewide Assessment

Statewide assessment would involve the following activities.

- For each grade level, select a random sample of 100 schools stratified by region of the state, school size, and school achievement. Within each school, randomly select one classroom containing 25 to 35 students from the classes of the targeted academic skills areas—at least math, science, and social studies; language arts, reading, and writing classes may be included.
- Obtain permission from selected schools and teachers to administer tests. Develop testing schedule.
- Produce approximately 3,500 answer documents and rating forms for each grade. Produce a minimum of 500 CD-ROMs. Make arrangements/generate protocols for using school computer systems and for alternative print materials for administration of the assessment.
- Deliver print documents, CD-ROMs, and notebooks to participating districts.
- Train district administrators. Complete testing within a two-week time period.
- Receive completed answer documents and printouts from electronic files from districts.
- Select, train, and monitor raters of constructed-response items.
- Produce data files for each grade level. Perform and report item analyses, reliability, and bias studies by grade level.

Potential Costs of Assessment

The following information provides an outline of the timeline, staffing requirements, list of deliverables, and estimated cost associated with the development of the problem-solving assessment for three grades, such as 5, 8, and 10. The estimated cost reported in this study is limited only to the cost of development and does not include the cost of administration.

The approximate time for the development of the problem-solving assessment would be 12 months and it would require the use of a number of professionals. Table C-6 illustrates a reasonable configuration of the core professional staff required during the development phase. The level of direction, management, psychometric, instructional, computer, editorial, graphic design, and related expertise can be provided through a different staffing pattern, but should cover the required areas of expertise at about the level indicated.

Table C-6
Project Staffing

Project Staffing			
Project Director	Half Time	Graphic Designer	Quarter Time
Project Manager	Full Time	Word Processor	Half Time
Psychometrician	Full Time	Graduate Assistant	Half Time
Instructional Designer/Programmer	Half Time	Graduate Assistant	Half Time
Editor	Half Time	Assistant Manager	Full Time
Proofer	Half Time		

In addition to the core project staffing, committee members will meet to accomplish the development and review activities. (See Table C-7.)

Table C-7
Committee Meetings

Committee Meetings	
Development Committee (30 members)	Five Meetings (10 days)
Review Committee (30 members)	Four Meetings (8 days)

Deliverables. The deliverables for the problem-solving assessment are shown below in Table C-8.

Table C-8

Deliverables

Deliverables	
Training Manual	Camera-Ready Copy, Electronic Copy, and 50 Hard Copies
Administration Manual	Camera-Ready Copy, Electronic Copy, and 50 Hard Copies
Grade #1 Test (such as fifth grade)	1000 Copies on CD-ROM and Print Format
Grade #2 Test (such as eighth grade)	1000 Copies on CD-ROM and Print Format
Grade #3 Test (such as tenth grade)	1000 Copies on CD-ROM and Print Format
Grade #1 Answer Document	Camera Ready and Electronic Copies
Grade #2 Answer Document	Camera Ready and Electronic Copies
Grade #3 Answer Document	Camera Ready and Electronic Copies
Grade #1 Test, Answer Key and Rubrics	Camera Ready and Electronic Copies
Grade #2 Test, Answer Key and Rubrics	Camera Ready and Electronic Copies
Grade #3 Test, Answer Key and Rubrics	Camera Ready and Electronic Copies

Total Cost. The total cost for the development and pilot testing of print and computer administration (CD-ROM) of the information literacy assessment is \$770,000. Table C-9 provides a breakdown of cost by category.

Table C-9

Cost Breakdowns

Breakdown of Cost by Category	
Personnel	\$522,500
Contractual Services	31,500
Travel	144,500
Materials and Supplies	27,500
Printing/Copying	10,000
Communication	14,000
Postage and Shipping	7,000
Equipment Maintenance	6,000
Capital Outlay	7,000
Total	\$770,000

The cost of development and pilot testing of only print administration for the problem-solving assessment is estimated at \$734,000.

Feasibility Statement

Development and administration of the multiple-choice/constructed-response test for problem solving is highly feasible from the point of view of cost, ease of administration, and scoring. Test items for this measure would include problem situations across a variety of contexts. Computer or print administration is feasible. Computer administration will support individualized self-paced assessment and allow fidelity to the context of problem solving related to computer problems. However, it is critical to prevent access to information files, such as an electronic encyclopedia, that might provide answers to some of the questions.

A problem-solving assessment could be undertaken at any time. Computer administration of the problem-solving assessment depends upon accessibility to computer systems and associated technologies at each school site. The microcomputing resources survey to be compiled by the Florida Office of Information Technology during the fall of 1997 will provide information to help in determining the resources for administration.

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STATEWIDE ASSESSMENT OF PROBLEM-SOLVING SKILLS

Feasibility Study

Appendices

Appendix C-1: Sunshine State Standards Referencing “Real-World Problems”

Appendix C-2: Sunshine State Standards with Applications to Real-World Problems

Appendix C-3: Critical Thinking, Analytical Thinking, and Problem Solving

Appendix C-4: SCANS Thinking Skills

Appendix C-5: Stimulus and Response Formats

Appendix C-6: Sample Item Formats

Appendix C-7: Comparison of Problem-Solving and Information Literacy Tasks

Appendix C-1
Sunshine State Standards Referencing “Real-World Problems”

MATHEMATICS

Grades 3–5	Grades 6–8	Grades 9–10
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NUMBER SENSE, CONCEPTS, AND OPERATIONS

Standard 1: The student understands the different ways numbers are represented and used in the real world.

3 understands concrete and symbolic representations of whole numbers, fractions, decimals, and percents in real-world situations	3 understands concrete and symbolic representations of rational numbers and irrational numbers in real-world situations	3 understands concrete and symbolic representations of real and complex numbers in real-world situations
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Standard 3: The student understands the effects of operations on numbers and the relationships among these operations, selects appropriate operations, and computes for problem solving.

3 adds, subtracts, and multiplies whole numbers, decimals, and fractions, including mixed numbers, and divides whole numbers to solve real-world problems, using appropriate methods of computing, such as mental mathematics, paper and pencil, and calculator	3 adds, subtracts, multiplies, and divides whole numbers, decimals, and fractions, including mixed numbers, to solve real-world problems, using appropriate methods of computing, such as mental mathematics, paper and pencil, and calculator	2 selects and justifies alternative strategies, such as using properties of numbers, including inverse, identity, distributive, associative, transitive, that allow operational shortcuts for computational procedures in real-world or mathematical problems
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Standard 4: The student uses estimation in problem solving and computation.

1 uses and justifies different estimation strategies in a real-world problem situation and determines the reasonableness of results of calculations in a given problem situation	1 uses estimation strategies to predict results and to check the reasonableness of results	1 uses estimation strategies in complex situations to predict results and to check the reasonableness of results
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Standard 5: The student understands and applies theories related to numbers.

1 applies special number relationships such as sequences and series to real-world problems
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Grades 3–5	Grades 6–8	Grades 9–10
MEASUREMENT		
<p><u>Standard 1:</u> <i>The student measures quantities in the real world and uses the measures to solve problems.</i></p>		
1 uses concrete and graphic models to develop procedures for solving problems related to measurement including length, weight, time, temperature, perimeter, area, volume, and angle 2 solves real-world problems involving length, weight, perimeter, area, capacity, volume, time, temperature, and angle	4 constructs, interprets, and uses scale drawings such as those based on number lines and maps to solve real-world problems	1 uses concrete and graphic models to derive formulas for finding perimeter, area, surface area, circumference, and volume of two- and three-dimensional shapes, including rectangular solids, cylinders, cones, and pyramids 2 uses concrete and graphic models to derive formulas for finding rate, distance, time, angle measures, and arc lengths 3 relates the concepts of measurement to similarity and proportionality in real-world situations
<p><u>Standard 2:</u> <i>The student compares, contrasts, and converts within systems of measurement (both standard/nonstandard and metric/customary)</i></p>		
1 selects and uses direct (measured) or indirect (not measured) methods of measurement as appropriate 2 solves real-world problems involving rated measures (miles per hour, feet per second)		
<p><u>Standard 3:</u> <i>The student estimates measurements in real-world problem situations.</i></p>		
1 solves real-world problems involving estimates of measurements, including length, time, weight, temperature, money, perimeter, area, and volume	1 solves real-world and mathematical problems involving estimates of measurements including length, time, weight/mass, temperature, money, perimeter, area, and volume, in either customary or metric units	1 solves real-world and mathematical problems involving estimates of measurements, including length, time, weight/mass, temperature, money, perimeter, area, and volume, and estimates the effects of measurement errors on calculations
<p><u>Standard 4:</u> <i>The student selects and uses appropriate units and instruments for measurement to achieve the degree of precision and accuracy required in real-world situations.</i></p>		
1 determines which units of measurement, such as seconds, square inches, dollars per tankful, to use with answers to real-world problems 2 selects and uses appropriate instruments and technology, including scales, rulers, thermometers, measuring cups, protractors, and gauges, to measure in real-world situations	1 selects appropriate units of measurement and determines and applies significant digits in a real-world context (Significant digits should relate to both instrument precision and to the least precise unit of measurement) 2 selects and uses appropriate instruments, technology, and techniques to measure quantities in order to achieve specified degrees of accuracy in a problem situation	1 determines the level of accuracy and precision, including absolute and relative errors or tolerance, required in real-world measurement situations 2 selects and uses appropriate instruments, technology, and techniques to measure quantities in order to achieve specified degrees of accuracy in a problem situation

Grades 3–5	Grades 6–8	Grades 9–10
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GEOMETRY AND SPATIAL SENSE

Standard 3: The student uses coordinate geometry to locate objects in both two and three dimensions and to describe objects algebraically.

1 represents and applies a variety of strategies and geometric properties and formulas for two- and three-dimensional shapes to solve real-world and mathematical problems

1 represents and applies geometric properties and relationships to solve real-world and mathematical problems

1 represents and applies geometric properties and relationships to solve real-world and mathematical problems including ratio, proportion, and properties of right triangle trigonometry

ALGEBRAIC THINKING

Standard 2: The student uses expressions, equations, inequalities, graphs, and formulas to represent and interpret situations.

2 uses informal methods, such as physical models and graphs to solve real-world problems involving equations and inequalities

1 represents and solves real-world problems graphically, with algebraic expressions, equations, and inequalities

1 represents real-world problem situations using finite graphs, matrices, sequences, series, and recursive relations

DATA ANALYSIS AND PROBABILITY

Standard 1: The student understands and uses the tools of data analysis for managing information.

2 determines range, mean, median, and mode from sets of data
3 analyzes real-world data to recognize patterns and relationships of the measures of central tendency using tables, charts, histograms, bar graphs, line graphs, pictographs, and circle graphs generated by appropriate technology, including calculators and computers

3 analyzes real-world data by applying appropriate formulas for measures of central tendency and organizing data in a quality display, using appropriate technology, including calculators and computers

3 analyzes real-world data and makes predictions of larger populations by applying formulas to calculate measures of central tendency and dispersion using the sample population data, and using appropriate technology, including calculators and computers

Standard 2: The student identifies patterns and makes predictions from an orderly display of data using concepts of probability and statistics.

1 determines probabilities using counting procedures, tables, tree diagrams, and formulas for permutations and combinations
2 determines the probability for simple and compound events as well as independent and dependent events

Standard 3: The student uses statistical methods to make inferences and valid arguments about real-world situations.

2 uses statistical data about life situations to make predictions and justifies reasoning

1 formulates hypotheses, designs experiments, collects and interprets data, and evaluates hypotheses by making inferences and drawing conclusions based on statistics (range, mean, median, and mode) and tables, graphs, and charts
2 identifies the common uses and misuses of probability and statistical analysis in the everyday world

1 designs and performs real-world statistical experiments that involve more than one variable, then analyzes results and reports findings
2 explains the limitations of using statistical techniques and data in making inferences and valid arguments

Appendix C-2
Sunshine State Standards with Applications to Real-World Problems

These standards seem to have applications to real-world problems even though they do not include the phrase “real-world” or “real-life” and often include “know that” rather than “solve” as part of the standard.

SCIENCE

Grades 3–5	Grades 6–8	Grades 9–10
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THE NATURE OF MATTER

Standard 1: The student understands that all matter has observable, measurable properties.

5 knows the difference between a physical change in a substance (i.e., altering the shape, form, volume, or density) and a chemical change (i.e., producing new substances with different characteristics)

1 experiments and determines that the rates of reaction among atoms and molecules depend on the concentration, pressure, and temperature of the reactants and the presence or absence of catalysts

ENERGY

Standard 1: The student recognizes that energy may be changed in form with varying efficiency.

6 knows ways that heat can move from one object to another

4 knows that energy conversions are never 100% efficient (i.e., some energy is transformed to heat and is unavailable for further useful work)

5 knows the processes by which thermal energy tends to flow from a system of higher temperature to a system of lower temperature

5 knows that each source of energy presents advantages and disadvantages to its use in society (e.g., political and economic implications may determine a society’s selection of renewable or nonrenewable energy sources)

7 knows that the total amount of reusable energy always decreases, even though the total amount of energy is conserved in any transfer

Standard 2: The student understands the interaction of matter and energy.

1 knows that most events in the universe (e.g., weather changes, moving cars, and the transfer of a nervous impulse in the human body) involve some form of energy transfer and that these changes almost always increase the total disorder of the system and its surroundings, reducing the amount of useful energy
2 knows that most of the energy used today is derived from burning stored energy collected by organisms millions of years ago (i.e., nonrenewable fossil fuels)

Grades 3–5	Grades 6–8	Grades 9–10
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FORCE AND MOTION

Standard 2: The student understands that the types of force that act on an object and the effect of that force can be described, measured, and predicted.

1 recognizes that forces of gravity, magnetism, and electricity operate simple machines

3 knows that if more than one force acts on an object, then the forces can reinforce or cancel each other, depending on their direction and magnitude

5 understands that an object in motion will continue at a constant speed and in a straight line until acted upon by a force and that an object at rest will remain at rest until acted upon by a force

6 explains and shows the ways in which a net force (i.e., the sum of all acting forces) can act on an object (e.g., speeding up an object traveling in the same direction as the net force, slowing down an object traveling in the direction opposite of the net force)

1 knows that all motion is relative to whatever frame of reference is chosen and that there is no absolute frame of reference from which to observe all motion

PROCESSES THAT SHAPE THE EARTH

Standard 2: The student recognizes that processes in the lithosphere, atmosphere, hydrosphere, and biosphere interact to shape the Earth.

1 knows that mechanical and chemical activities shape and reshape the Earth's land surface by eroding rock and soil in some areas and depositing them in other areas, sometimes in seasonal layers
3 knows that conditions that exist in one system influence the conditions that exist in other systems

4 knows the ways in which plants and animals reshape the landscape (e.g., bacteria, fungi, worms, rodents, and other organisms add organic matter to the soil, increasing soil fertility, encouraging plant growth, and strengthening resistance to erosion)

1 knows how climatic patterns on Earth result from an interplay of many factors (Earth's topography, its rotation on its axis, solar radiation, the transfer of heat energy where the atmosphere interfaces with lands and oceans, and wind and ocean currents)

Standard 2: The student understands the need for protection of the natural systems on earth.

1 knows that using, recycling, and reducing the use of natural resources improves and protects the quality of life

1 understands that quality of life is relevant to personal experience
2 knows the positive and negative consequences of human action on the Earth's systems

1 understands the interconnectedness of the systems on Earth and the quality of life

Grades 3–5	Grades 6–8	Grades 9–10
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EARTH AND SPACE

Standard 1: The student understands the interaction and organization in the Solar System and the universe and how this affects life on Earth.

- 1 understands the relationships between events on Earth and the movements of the Earth, its Moon, the other planets, and the Sun

PROCESSES OF LIFE

Standard 1: The student describes patterns of structure and function in living things.

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| <p>7 knows that behavior is a response to the environment and influences growth, development, maintenance, and reproduction</p> | <p>4 understands that biological systems obey the same laws of conservation as physical systems</p> |
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- 7 knows that organisms respond to internal and external stimuli

Standard 2: The student understands the process and importance of genetic diversity.

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| <p>4 knows that the fossil record provides evidence that changes in the kinds of plants and animals in the environment have been occurring over time</p> | <p>3 understands the mechanisms of change (e.g., mutation and natural selection) that lead to adaptations in a species and their ability to survive naturally in changing conditions and to increase species diversity</p> |
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HOW LIVING THINGS INTERACT WITH THEIR ENVIRONMENT

Standard 1: The student understands the competitive, interdependent, cyclic nature of living things in the environment.

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| <p>6 knows that organisms are growing, dying, and decaying and that new organisms are being produced from the materials of dead organisms</p> | <p>2 knows that biological adaptations include changes in structures, behaviors, or physiology that enhance reproductive success in a particular environment</p> | <p>2 understands how the flow of energy through an ecosystem made up of producers, consumers, and decomposers carries out the processes of life and that some energy dissipates as heat and is not recycled</p> |
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7 knows that variations in light, water, temperature, and soil content are largely responsible for the existence of different kinds of organisms and population densities in an ecosystem

- 4 knows that the interactions of organisms with each other and with the non-living parts of their environments result in the flow of energy and the cycling of matter throughout the system

Standard 2: The student understands the consequences of using limited natural resources.

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| <p>1 knows that all living things must compete for Earth's limited resources; organisms best adapted to compete for the available resources will be successful and pass their adaptations (traits) to their offspring</p> | <p>1 knows that some resources are renewable and others are not</p> | <p>2 knows that changes in a component of an ecosystem will have unpredictable effects on the entire system but that the components of the system tend to react in a way that will restore the ecosystem to its original condition</p> |
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2 knows that the size of a population is dependent upon the available resources within its community

- 2 knows that all biotic and abiotic factors are interrelated and that if one factor is changed or removed, it impacts the availability of other resources within the system

- 3 understands how genetic variation of offspring contributes to population control in an environment and that natural selection ensures that those who are best adapted to their surroundings survive to reproduce

Grades 3–5	Grades 6–8	Grades 9–10
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HOW LIVING THINGS INTERACT WITH THEIR ENVIRONMENT (CONTINUED)

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| <p>3 understands that changes in the habitat of an organism may be beneficial or harmful</p> | <p>3 knows that a brief change in the limited resources of an ecosystem may alter the size of a population or the average size of individual organisms and that long-term change may result in the elimination of animal and plant populations inhabiting the Earth
 4 understands that humans are a part of an ecosystem and their activities may deliberately or inadvertently alter the equilibrium in ecosystems</p> | <p>4 knows that the world ecosystems are shaped by physical factors that limit their productivity
 5 understands that the amount of life any environment can support is limited and that human activities can change the flow of energy and reduce the fertility of the Earth
 6 knows the ways in which humans today are placing their environmental support systems at risk (e.g., rapid human population growth, environmental degradation, and resource depletion)</p> |
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THE NATURE OF SCIENCE

Standard 1: The student uses the scientific processes and habits of mind to solve problems.

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| <p>2 knows that a successful method to explore the natural world is to observe and record, and then analyze and communicate the results
 3 knows that to work collaboratively, all team members should be free to reach, explain, and justify their own individual conclusions
 4 knows that to compare and contrast observations and results is an essential
 5 knows that a model of something is different from the real thing</p> | <p>1 knows that scientific knowledge is subject to modification as new information challenges prevailing theories and as a new theory leads to looking at old observations in a new way
 4 knows that accurate record keeping, openness, and replication are essential to maintaining an investigator's credibility with other scientists and society
 5 knows that a change in one or more variables may alter the outcome of an investigation
 7 knows that when similar investigations give different results, the scientific challenge is to verify whether the differences are significant by further study</p> | <p>3 understands that no matter how well one theory fits observations, a new theory might fit them as well or better, or might fit a wider range of observations, because in science, the testing, revising, and occasional discarding of theories, new and old, never ends and leads to an increasingly better understanding of how things work in the world, but not to absolute truth
 4 knows that scientists in any one research group tend to see things alike and that therefore scientific teams are expected to seek out the possible sources of bias in the design of their investigations and in their data analysis
 5 understands that new ideas in science are limited by the context in which they are conceived, are often rejected by the scientific establishment, sometimes spring from unexpected findings, and usually grow slowly from many contributors
 6 understands that in the short run, new ideas that do not mesh well with mainstream ideas in science often encounter vigorous criticism and that in the long run, theories are judged by how they fit with other theories, the range of observations they explain, how well they explain observations, and how effective they are in predicting new findings
 7 understands the importance of a sense of responsibility, a commitment to peer review, truthful reporting of the methods and outcomes of investigations, and making the public aware of the findings</p> |
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Grades 3–5	Grades 6–8	Grades 9–10
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THE NATURE OF SCIENCE (CONTINUED)

***Standard 2:** The student understands that most natural events occur in comprehensible, consistent patterns.*

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| 1 knows that natural events are often predictable and logical | 2 knows that scientists control conditions in order to obtain evidence, but when that is not possible for practical or ethical reasons, they try to observe a wide range of natural occurrences to discern patterns |
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***Standard 3:** The student understands that science, technology, and society are interwoven and interdependent.*

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| <p>1 understands that people, alone or in groups, invent new tools to solve problems and do work that affects aspects of life outside of science</p> <p>2 knows that data are collected and interpreted in order to explain an event or concept</p> <p>3 knows that before a group of people build something or try something new, they should determine how it may affect other people</p> <p>4 knows that through the use of science processes and knowledge, people can solve problems, make decisions, and form new ideas</p> | <p>1 knows that science ethics demand that scientists must not knowingly subject coworkers, students, the neighborhood, or the community to health or property risks</p> <p>2 knows that special care must be taken in using animals in scientific research</p> <p>3 knows that in research involving human subjects, the ethics of science require that potential subjects be fully informed about the risks and benefits associated with the research and of their right to refuse to participate</p> <p>4 knows that technological design should require taking into account constraints such as natural laws, the properties of the materials used, and economic, political, social, ethical, and aesthetic values</p> <p>5 understands that contributions to the advancement of science, mathematics, and technology have been made by different kinds of people, in different cultures, at different times and are an intrinsic part of the development of human culture</p> | <p>1 knows that performance testing is often conducted using small-scale models, computer simulations, or analogous systems to reduce the chance of system failure</p> <p>2 knows that technological problems often create a demand for new scientific knowledge and that new technologies make it possible for scientists to extend their research in a way that advances science</p> <p>3 knows that scientists can bring information, insights, and analytical skills to matters of public concern and help people understand the possible causes and effects of events</p> <p>5 knows that the value of a technology may differ for different people at different times</p> <p>6 knows that scientific knowledge is used by those who engage in design and technology to solve practical problems, taking human values and limitations into account</p> |
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SOCIAL STUDIES

Grades 3–5	Grades 6–8	Grades 9–10
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TIME, CONTINUITY, AND CHANGE

Standard 1: The student understands historical chronology and the historical perspective.

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| <p>1 understands how individuals, ideas, decisions, and events can influence history</p> <p>2 uses a variety of methods and sources to understand history (such as interpreting diaries, letters, newspapers; and reading maps and graphs) and knows the difference between primary and secondary sources</p> | <p>1 understands how patterns, chronology, sequencing (including cause and effect), and the identification of historical periods are influenced by frames of reference</p> <p>2 knows the relative value of primary and secondary sources and uses this information to draw conclusions from historical sources such as data in charts, tables, graphs</p> | <p>2 identifies and understands themes in history that cross scientific, economic, and cultural boundaries</p> <p>3 evaluates conflicting sources and materials in the interpretation of a historical event or episode</p> <p>4 uses chronology, sequencing, patterns, and periodization to examine interpretations of an event</p> |
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Standard 2: The student understands the world from its beginnings to the time of the Renaissance.

- 1 understands how language, ideas, and institutions of one culture can influence other cultures (e.g., through trade, exploration, and immigration)

Standard 3: The student understands Western and Eastern civilization since the Renaissance.

- 9 analyzes major historical events of the first half of the 20th century

Standard 5: The student understands U.S. history from 1880 to the present day.

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| <p>1 understands the role of physical and cultural geography in shaping events in the United States since 1880 (e.g., western settlement, immigration patterns, and urbanization)</p> <p>2 knows the causes and consequences of urbanization that occurred in the United States after 1880 (e.g., causes such as industrialization, consequences such as poor living conditions in cities and employment conditions)</p> |
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Standard 6: The student understands the history of Florida and its people.

- 4 understands the perspectives of diverse cultural, ethnic, and economic groups with regard to past and current events in Florida's history

Grades 3–5	Grades 6–8	Grades 9–10
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PEOPLE, PLACES, AND ENVIRONMENT

Standard 1: *The student understands the world in spatial terms.*

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| <p>1 uses maps, globes, charts, graphs, and other geographic tools including map keys and symbols to gather and interpret data and to draw conclusions about physical patterns</p> <p>2 knows how regions are constructed according to physical criteria and human criteria</p> <p>5 knows ways in which people view and relate to places and regions differently</p> | <p>1 uses various map forms (including thematic maps) and other geographic representations, tools, and technologies to acquire, process, and report geographic information including patterns of land use, connections between places, and patterns and processes of migration and diffusion</p> <p>2 uses mental maps to organize information about people, places, and environments</p> <p>4 understands how factors such as culture and technology influence the perception of places and regions</p> <p>5 knows ways in which the spatial organization of a society changes over time</p> <p>6 understands ways in which regional systems are interconnected</p> <p>7 understands the spatial aspects of communication and transportation systems</p> | <p>1 uses a variety of maps, geographic technologies including geographic information systems (GIS) and satellite-produced imagery, and other advanced graphic representations to depict geographic problems</p> <p>2 understands the advantages and disadvantages of using maps from different sources and different points of view</p> <p>3 uses mental maps of physical and human features of the world to answer</p> <p>4 understands how cultural and technological characteristics can link or divide regions</p> <p>5 understands how various factors affect people's mental maps</p> |
|---|---|--|

Standard 2: *The student understands the interactions of people and the physical environment.*

- | | | |
|--|--|---|
| <p>2 understands how the physical environment supports and constrains human activities</p> <p>3 understands how human activity affects the physical environment</p> <p>4 understands how factors such as population growth, human migration, improved methods of transportation and communication, and economic development affect the use and conservation of natural resources</p> | <p>1 understands the patterns and processes of migration and diffusion throughout the world</p> <p>2 knows the human and physical characteristics of different places in the world and how these characteristics change over time</p> <p>3 understands how cultures differ in their use of similar environments and resources</p> <p>5 understands the geographical factors that affect the cohesiveness and integration of countries</p> <p>6 understands the environmental consequences of people changing the physical environment in various world locations</p> <p>9 understands how the interaction between physical and human systems affects current conditions on Earth</p> | <p>1 understands how social, cultural, economic, and environmental factors contribute to the dynamic nature of regions</p> <p>2 understands past and present trends in human migration and cultural interaction and their impact on physical and human systems</p> <p>3 understands how the allocation of control of the Earth's surface affects interactions between people in different regions</p> <p>4 understands the global impact of human changes in the physical environment</p> <p>5 knows how humans overcome "limits to growth" imposed by physical systems</p> |
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Grades 3–5	Grades 6–8	Grades 9–10
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GOVERNMENT AND THE CITIZEN [CIVICS AND GOVERNMENT]

Standard 1: *The student understands the structure, functions, and purposes of government and how the principles and values of American democracy are reflected in American constitutional government.*

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|--|---|---|
| <p>4 knows possible consequences of the absence of government, rules, and laws</p> | <p>3 understands how the legislative, executive, and judicial branches share power and responsibilities (e.g., each branch has varying degrees of legislative, executive, and judicial powers and responsibilities)</p> | <p>3 understands how the overall design and specific features of the Constitution prevent the abuse of power by aggregating power at the national, state, and local levels; dispersing power among different levels of government; and using a system of checks and balances (e.g., federalism)</p> <p>4 understands the role of special interest groups, political parties, the media, public opinion, and majority/minority conflicts on the development of public policy and the political process</p> |
|--|---|---|

Standard 2: *The student understands the role of the citizen in American democracy.*

- | | | |
|--|---|---|
| <p>5 knows what constitutes personal, political, and economic rights and why they are important and knows examples of contemporary issues regarding rights</p> | <p>4 understands what constitutes personal, political, and economic rights and the major documentary sources of these rights</p> <p>7 understands current issues involving rights that affect local, national, or international political, social, and economic systems</p> | <p>2 assesses the role that his or her own political behavior plays in determining the flow of power through our political system and for resolving conflicts in a pluralistic society</p> <p>3 understands issues of personal concern: the rights and responsibilities of the individual under the U.S. Constitution, the importance of civil liberties, the role of conflict resolution and compromise, and issues involving ethical behavior in politics</p> <p>7 knows the points at which citizens can monitor or influence the process of public policy formation</p> |
|--|---|---|

ECONOMICS

Standard 1: *The student understands how scarcity requires individuals and institutions to make choices about how to use resources.*

- | | | |
|--|--|---|
| <p>1 understands that all decisions involve opportunity costs and that making effective decisions involves considering the costs and benefits associated with alternative choices</p> <p>2 understands that scarcity of resources requires choices on many levels, from the individual to societal</p> | <p>2 understands the advantages and disadvantages of various kinds of credit (e.g., credit cards, bank loans, or financing with no payment for 6 months)</p> <p>3 understands the variety of factors necessary to consider when making consumer wise decisions</p> | <p>1 understands how many financial and nonfinancial factors (e.g., cultural, traditions, profit, and risk) motivate consumers, producers, workers, savers, and investors to allocate their scarce resources differently</p> <p>2 understands credit history and the positive and negative impacts that credit can have on an individual's financial life</p> |
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Grades 3–5	Grades 6–8	Grades 9–10
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ECONOMICS (CONTINUED)

Standard 1: The student understands the characteristics of different economic systems and institutions.

1 understands economic specialization and how specialization generally affects costs, amount of goods and services produced, and interdependence
 2 understands the roles that money plays in a market economy

1 understands how production and distribution decisions are determined in the United States economy and how these decisions compare to those made in market, tradition-based, command, and mixed economic systems
 2 understands that relative prices and how they affect people's decisions are the means by which a market system provides answers to the three basic economic questions: What goods and services will be produced? How will they be produced? Who will buy them?

1 understands how wages and prices are determined in market, command, tradition-based, and mixed economic systems and how economic systems can be evaluated by their ability to achieve broad social goals such as freedom, efficiency equity, security, and growth
 2 understands how price and quantity demanded relate, how price and quantity supplied relate, and how price changes or controls affect distribution and allocation in the economy
 3 understands how government taxes, policies, and programs affect individuals, groups, businesses, and regions
 4 understands how United States fiscal policies and monetary policies reinforce or offset each other and how they affect levels of economic activity, the money supply of the country, and the well-being of individuals, businesses, regions, and the nation
 6 understands factors that have led to increased international interdependence and basic concepts associated with trade between nations

Appendix C-3
Critical Thinking, Analytical Thinking, and Problem Solving

TASKS	RESEARCH REPORTS														
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
1. view reality; sense/reflect/recognize real problem	✓	✓		✓		✓			✓			✓	✓		
2. commit energy/motivation to solve/decide goals; self-talk/confidence, perseverance, flexibility	✓	✓						✓				✓	✓	✓	✓
3. define problems/purposes/assumptions/puzzling, ambiguous facts/success criteria—internal/external (real world)			✓	✓	✓	✓	✓		✓	✓		✓	✓		
4. identify/infer from relevant/irrelevant/sufficient information				✓					✓			✓			
5. recall concepts/structures/solutions/facts/rules/procedures			✓					✓				✓	✓	✓	✓
6. plan/match tools/strategies/knowledge; identify/organize steps/questions to view/solve/monitor self/progress	✓	✓			✓		✓	✓	✓		✓	✓	✓	✓	✓
7. search facts/expertise/issues/context/group mind/circumstances	✓				✓					✓		✓			
8. select/gather/organize/interpret information/perspectives; observe effects of concepts/rules; use rules	✓	✓	✓		✓	✓			✓	✓					
9. analyze information/patterns/parts/values/subarguments	✓	✓			✓		✓	✓	✓	✓	✓	✓	✓	✓	✓
10. find elements/relationships/good, bad ideas/interests/span of factors/assumptions/values	✓	✓			✓				✓	✓		✓			
11. use constraints to reduce problem/solution space				✓		✓		✓							
12. keep open mind when gathering/analyzing information					✓	✓							✓		
13. explore ideas/outside structures; think broadly of all important factors/relationships/people/possibilities						✓	✓				✓		✓		
14. identify instances of concepts; use labels/outlines/graphs/tables/logic/math/musical/ visual symbols						✓				✓		✓	✓	✓	✓
15. organize/simplify/focus/classify/group/categorize/sequence/synthesize situations/relationships/facts; find central ideas	✓	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		
16. summarize/integrate key elements/arguments									✓				✓		
17. compare/contrast; apply whole-part-whole/cause-effect/similarities/other connections/see errors											✓		✓		✓
18. recall/use deductive/inductive reasoning; identify errors/stereotypes/clichés/prejudices/opinions							✓		✓	✓	✓	✓	✓	✓	✓
19. recast/restructure/compare problem/solution/information—analogy/model/paradigm/schemata	✓	✓			✓		✓				✓	✓	✓	✓	✓
20. recognize fact/opinion/true/false/agreement/disagreement; evidence/support/conclusion						✓		✓		✓	✓	✓			
21. recognize ambiguities, when to avoid/tolerate/estimate						✓					✓				
22. recognize/analyze interpretations/perspectives/emotions/ ego motives/power plays/traditions	✓					✓		✓		✓	✓	✓			
23. use team skills/ways to settle conflicts	✓														
24. form hypotheses/conclusions; generalize; predict/forecast alternative short/long-term consequences/implications	✓	✓			✓	✓		✓		✓					
25. select/use internal/external criteria; evaluate/judge	✓	✓			✓	✓				✓		✓	✓	✓	✓
26. estimate risks/trade-offs; judge/set priorities	✓				✓										
27. express ideas about solutions, problems; explain reasoning										✓			✓		
28. decide/select/reject; blend values/logic/information; defend	✓	✓			✓	✓		✓				✓	✓		
29. generate/identify (new) alternatives/choices							✓						✓		
30. choose how/test solutions/hypotheses/conclusions; implement/revise/plan/multi-step procedures; recover from failure	✓	✓			✓	✓			✓	✓	✓	✓	✓	✓	✓
31. solve within time limits; rapidly execute subskills	✓						✓								

Note. Task statements include key words from publications. For example, the first task includes view reality because this was a key term from one source. It includes sense/reflect/recognize real problem because descriptions in reports referred to finding real problems, sensing a problem, to reflecting about a problem, and to recognizing one. These terms seem to express the same type of task—recognizing a real problem. This chart includes 31 task statements from the following 15 references.

References

- A**—Adelson, 1976, p. 43
- B**—Baird, 1983, pp. 31–41
- C**—Clayton College, in Carpenter & Doig, pp. 42–43
- D**—Covington, Crutchfield, Davies, and Olton (1974), in Segal, Chipman, & Glaser, 1985, pp. 429–430
- E**—de Bono, 1985, pp. 375–379
- F**—Eble, 1986, p. 4
- G**—Glaser, Baxter, and Raghavan, 1992, in Sugrue, 1994, pp. 4–5
- H**—King's College, in Carpenter & Doig, pp. 40–41
- I**—Kohler, 1927, in Segal, Chipman, & Glaser, 1985, p. 11
- J**—Lipman, 1985, pp. 88–96
- K**—Masters, 1986, p. 5 (cf. 1992)
- L**—Miles, 1985, pp. 483–488
- M**—Rankin, 1987, pp. 9–15
- N**—Schoenfeld, 1985, cited in Sugrue, 1994, p. 5
- O**—Smith, 1991, cited in Sugrue, 1994, pp. 5–6

Appendix C-4
SCANS Thinking Skills

CREATIVE THINKING—generates new ideas	
explore ideas/outside structures; think broadly of all important factors/relationships/people/possibilities	keep open mind in gathering/analyzing information
DECISION MAKING—specifies goals and constraints, generates alternatives, considers risks, and evaluates and chooses best alternative	
commit energy/motivation to solve/decide goals; self-talk/confidence, perseverance, flexibility	recognize/analyze interpretations/perspectives/emotions/ego motives/power plays/traditions
use constraints to reduce problem/solution space	select/use internal/external criteria; evaluate/judge
estimate risks/trade-offs, judge/set priorities	decide/select/reject; blend values/logic/information; defend
PROBLEM SOLVING—recognizes problems and devises and implements plan of action	
view reality; sense/reflect/recognize real problem	summarize/integrate key elements/arguments
define real problem/purposes/assumptions/success criteria—internal/external (real world); identify, explain odd or puzzling facts/factors/ambiguities	plan how to solve; match tools/strategies/ knowledge; identify/organize steps/questioning techniques to view/solve/monitor self/progress
identify relevant/irrelevant/sufficient information; infer from information given about problem	choose how/test solutions/hypotheses/conclusions; implement/revise plan/multi-step procedures; recover from failure
use team skills/ways to settle conflicts	solve within time limits; rapidly execute skills
SEEING THINGS IN THE MIND'S EYE—organizes and processes symbols, pictures, graphs, objects, and other information	
identify instances of concept; use labels/outlines/graphs/tables/logic/math/musical/visual symbols	recast/restructure/compare problem/solution/ information—analogy/model/paradigm/schemata
KNOWING How to LEARN—uses efficient learning techniques to acquire and apply new knowledge and skills	
recall knowledge/concepts/structures/solutions/ domain-specific facts/rules/procedures	recall/use deductive, inductive reasoning; identify errors/stereotypes/clichés/prejudices/opinions
apply search strategies for facts/expertise/issues/ context/group mind/ circumstances	recognize fact/opinion/ true/false; agreement/ disagreement; evidence/support/conclusion
recognize ambiguities, when to avoid or tolerate them, when to estimate	express/communicate ideas about solutions, problems; explain reasoning
REASONING—discovers a rule or principle underlying the relationship between two or more objects and applies it when solving a problem	
find elements/relationships/good/bad ideas/ interests/span of factors/assumptions/values	compare/contrast; apply whole-part-whole/cause-effect/similarities/other connections/see errors
organize/simplify/focus/ synthesize relationships/ situations/ all facts; find central theme/idea; classify/group/ categorize; sequence information	analyze problems/information/ patterns/parts/values/subproblems/subarguments
select/gather/organize/interpret information/perspectives; make observations; observe effects of concepts/rules; use rules	form hypotheses/conclusions; generalize; predict alternative short/long-term consequences/implications; forecast

Appendix C-5
Stimulus and Response Formats
APPLICATION SKILLS (Bloom, 1956)

The test situation PROVIDES:	The examinee SELECTS/GENERATES/EXPLAINS:
a fictional situation; a new slant on situations which to the group being tested are common and mundane; content that the examinee is unlikely to know such as simplified version of complex material that ordinarily comes much later in study	<p>selects/generates the principle(s) that apply to solving a problem, and the explanation or reasons that justify the principle(s)</p> <p>selects/generates a solution, principle(s) for solving a problem, and the explanation or reasons for the principle(s)</p> <p>selects principle(s), a prediction, reasons for the principle(s) that form the prediction</p> <p>explains a conclusion OR selects several principle(s) to explain outcomes/conclusions</p>
a literary passage, description of a scientific experiment or social situation, set of data, argument, picture, musical selection	<p>selects elements of logic (unstated assumptions, premises, conclusions), consistency or inconsistency, relationships, organization, structure, facts, judgment of evidence and selects reasons that justify a conclusion</p>

PRINCIPLES (Bloom, 1956; Norris, 1984; Sugrue, 1995)

The test situation PROVIDES:	The examinee SELECTS:
description or simulation and options	the most appropriate prediction or solutions
situation and alternative predictions	the most probable prediction
list of possible events	the event that is most likely to occur
principle	a solution or prediction
situation (sources or conflicting observations) to which criteria of <i>credibility</i> may be applied	the more credible source or observation
situation with the facts/evidence for drawing a conclusion/direction and alternatives	the most appropriate conclusion or direction supported by the facts/evidence
argument with unstated assumptions	the unstated assumptions
argument with conclusions	which one(s) follow, contradict, or do neither
The test situation PROVIDES:	The examinee GENERATES:
situation requiring a prediction or solution	prediction or solution
The test situation PROVIDES:	The examinee EXPLAINS:
situation with a prediction or solution	prediction or solution
a more credible source or observation	reasons for the credibility/choice
conclusion/direction drawn from facts/evidence	reasons to justify the conclusion or direction
unstated assumptions of argument/explanation	reasoning that leads to unstated assumptions
conclusions that follow from an argument, contradict it, or do neither	reasoning for judging that conclusions follow from, contradict, or do neither

PROCEDURES (Bloom, 1956; Norris, 1984; Sugrue, 1995)

The test situation PROVIDES:	The examinee SELECTS:
descriptions or simulations of a number of different procedures for accomplishing a particular goal	most appropriate procedure for the task OR correct order or errors made in someone else's performance of the procedure
name of a procedure with possible steps	the steps that match the procedure
situation and questions about how to produce one or more product(s) for the situation, or one or more problems that arise because of one or more variables or factors	ways to perform operations; statements about how to apply rules; hypotheses that apply and a solution or plan that evolves from them; a plan/solution/inferences, principles, and explanations for principles applied or inferences
The test situation PROVIDES:	The examinee GENERATES:
procedure label	performance of the procedure
a situation and a possible change introduced into the situation	description of what would happen when the change is introduced
materials in a laboratory, interactions in a group situation, or other field situation	free or guided responses
assignment to produce a product or a problem to solve by producing a product	product(s), such as an essay, an architectural design, a musical arrangement,
The test situation PROVIDES:	The examinee EXPLAINS:
name or label of a procedure to perform	how to perform the procedure
a new work or idea to which specific criteria or ends may be applied—a problem, possible conclusions, and statements that justify conclusions; situation requiring judgment about accuracy; product to evaluate; a means-end relationship	conclusion and reasons; criteria to apply and the corresponding judgment(s); statement expressing an appropriate judgment about a means-end relationship; means that will best serve the end (purpose)

The following formats alone would be insufficient to assess problem-solving skills. They are useful for assessing concepts or for diagnostic assessment of problem-solving capabilities

CONCEPTS (Bransford, Arbitman-Smith, Stein, & Vye 1985; Sugrue, 1995)

The test item PROVIDES:	The examinee SELECTS:
multiple examples of (a) concept	examples that belong to the concept
list of concept labels and mixed examples	match of examples to concept labels
The test item PROVIDES:	The examinee GENERATES:
concept label	example or instance
an analogy	an original example of an analogy
The test item PROVIDES:	The examinee EXPLAINS:
examples of concepts	why examples reflect concept attributes

Appendix C-6

Sample Item Formats

- 1** Bloom (1956)—conclusion and reasons in multiple-choice format
- 2** Bloom (1956)—predictions from principles and inferences about information in multiple-choice format
- 3** Bloom (1956)—decisions in multiple-choice format; and explanations in multiple-choice format
- 4** Missimer (1987)—decisions, predictions from chart of information in multiple-choice format
- 5** Kneedler (1988)—inference in multiple-choice format; and interpretation of visual data in multiple-choice format
- 6** Kneedler (1988)—conclusion from visual data in multiple-choice format (2 examples)
- 7** Sugrue (1995)—prediction about multiple variables in tabular multiple-choice format
- 8** Educational Testing Service (1987)—inference and explanation in constructed-response format
- 9** Katims, Nash, & Tocci (1993)—sample of real-life media excerpts about which items could be generated
- 10** FCAT (1997)—multiple tasks with explanation in constructed-response format

Given a problem, determine a logical conclusion and judge the logical accuracy of statements in relation to the conclusion

Social Security officials sometimes face perplexing problems in studying appeals for unemployment compensation. Some major-league baseball players in Ohio and Missouri decided in January that, because they had not played ball since the end of the season, they had a right to consider themselves unemployed. Although some of them were earning good salaries of \$8,000 to \$10,000 a year in baseball, they maintained that they were entitled to the benefits of the unemployment section of the Social Security Act.

Team owners urged these players not to apply for unemployment compensation. According to the owners' interpretation, the players were under contract all year around, although they worked and were paid only during the playing season. On the other hand, the state officials in Ohio and Missouri were inclined to agree with the players that they were entitled to benefit payments.

Directions: Examine the conclusions given below. Assuming that the paragraphs above give a fair statement of the problem, which one of the conclusions do you think is justified.

Conclusions

- A. The players were entitled to the benefits of the unemployment section of the Social Security Act.
- B. The players were not entitled to the benefits of the unemployment section of the Social Security Act.
- C. More information is needed to decide whether or not the players were entitled to the benefits of the unemployment section of the Social Security Act.

Mark your column	<p>A: Statements which explain why your conclusion is logical.</p> <p>B: Statements which do not explain your conclusion is logical.</p> <p>C: Statements about which you are unable to decide.</p>
---------------------	---

Statements

1. The state officials are the ones who consider appeals for unemployment compensation, and their opinion carries more weight than the opinions of team owners.
2. The Social Security Act may or may not provide that a man who works and receives pay during only part of each year is unemployed during the remaining part of the year.
3. The players argued indirectly (if others receive compensation, why shouldn't we?) and forgot that others needed the compensation more than they.
4. A changed definition may lead to a changed conclusion even though the argument from each definition is logical.
5. No one who earns \$8,000 a year or more should get unemployment compensation.

(Source PEA Test 5.12)

Bloom (1956)

Behavior. The student must determine the general principles which operate in the situation described and then predict the most likely event. (Type 3)
Situation. A fictional situation. (Type A)

15. Mr. Golzak, Mr. A. F. Fell, Mrs. Hunter, and Boss Powers live in Steel City.
Mr. Golzak was born 60 years ago in Central Europe. Today Mr. Golzak is one of Steel City's top business leaders. The Golzak family has "arrived". Wealthy Mrs. Golzak dominates the social life of their swank suburb, Mapledale. Mr. Golzak, personnel manager for Amalgamated Steel, believes in "rugged individualism." Personal freedom allows enterprising men (such as himself) to achieve wealth and position, just as freedom from governmental restraint for business assures national prosperity and a "full dinner pail" for all. Mr. Golzak believes labor unions destroy workers' initiative and undermine business.

Mr. A. F. Fell was born in Steel City in a working-class neighborhood. Like his father, Mr. Fell became a printer's apprentice at 16, and then a life-long member of the International Typographical Workers Union. He works as a typesetter for the "Steel City Sentinel." Mr. Fell believes that management and labor should settle their differences entirely between themselves by collective bargaining. Mr. Fell makes \$1.90 per hour, owns his own home and sends his children to the city junior college. He believes his union has made this possible.

Mrs. Hunter is the wife of a steel worker. Mr. Hunter belongs to the CIO. The Hunters and three other families share a "modest" home (owned by Mr. Golzak) three blocks downwind from the steel mill. Mrs. Hunter attended a Southern school for Negroes for four years, off and on. She has little understanding of social and economic problems, but she worries over such personal problems as clothing for four growing children, privacy in her own home, paying the butcher during the steel strike, and Junior who "borrows" bicycles.

Boss Powers slum-born son of an Irish saloon-keeper, learned conviviality early in life and led his gang against the Prairie Avenue Dukes. Soon he was leading his Ward Organization against the Republicans. Today he is unquestioned as Democratic Boss of Steel City. He enjoys the fruit of victory.

1. A business recession would probably mean unemployment for (A- the Fells and the Hunters; B- Boss Powers; C- the Hunters; D- none of these).
2. Mr. Fell's home is probably (A- near the steel mill; B- in Mapledale; C- in the zone of transition; D- among twenty-year-old single dwelling units).
3. A bill is before Congress to admit an additional 100,000 displaced persons. Most likely to favor the bill is (A- Mr. Golzak, personnel manager for Amalgamated Steel; B- Mrs. Hunter, wife of an unskilled laborer; C- Mr. Fell, skilled craftsman; D- Boss Powers, son of an immigrant).
4. Mrs. Fell has chronic headaches although her doctor can find nothing organically wrong with her. Her headaches are most probably a result of (A- personal maladjustment; B- approaching insanity; C- hidden germs; D- an inherited mental weakness).

Bloom (1956)

20. Jane is faced with the problem of selecting material for a school dress. The dress will receive lots of wear and will be laundered frequently. Which of the fabrics would be her best choice? (The test should include examples of fabrics, including some rayons. This would allow more reasons to be given below.)

Check the qualities the fabric you choose possesses which make it superior for Jane's purpose.

- (a) Material is colorfast to washing
- (b) Material is crease resistant
- (c) There is little or no sizing in the material
- (d) Material is easily cared for
- (e) Material is soft and will drape easily
- (f) Weave is firm, close and smooth
- (g) Material is colorfast to sunlight
- (h) Material will not show soil easily
- (I) Design is printed with the grain

5. Several authorities were asked to participate in a round table discussion of juvenile delinquency. They were given the following data about City X and for three communities, A, B, and C within City X.

	For City X <u>as a whole</u>	For Com- munity A	For Com- munity B	For Com- munity C
Juvenile Delinquency Rate (annual arrests per 100 persons aged 5-19)	4.24	18.1	1.3	4.1
Average Monthly Rental	\$60.00	\$42.00	\$100.00	\$72.00
Infant Death Rate (per 1000 births)	52.3	76.0	32.1	56.7
Birth Rate (per 1000 inhabitants)	15.5	16.7	10.1	15.4

In addition, they were told that in Community A the crimes against property (burglary, etc.) constituted a relatively higher proportion of the total juvenile offenses than in Communities B and C, where crimes against persons (assault, etc.) were relatively greater.

- (1) How would you explain the differences in these juvenile delinquency rates in light of the above data? (You may make use of any theory or material presented in the course.)
- (2) In light of your explanation of the data what proposals would you make for reducing the juvenile delinquency rate in each of the three communities?

Bloom (1956)

Example of the Information Table Approach

Below is information a school counselor has gathered about five careers. Study this information, then answer the questions below.

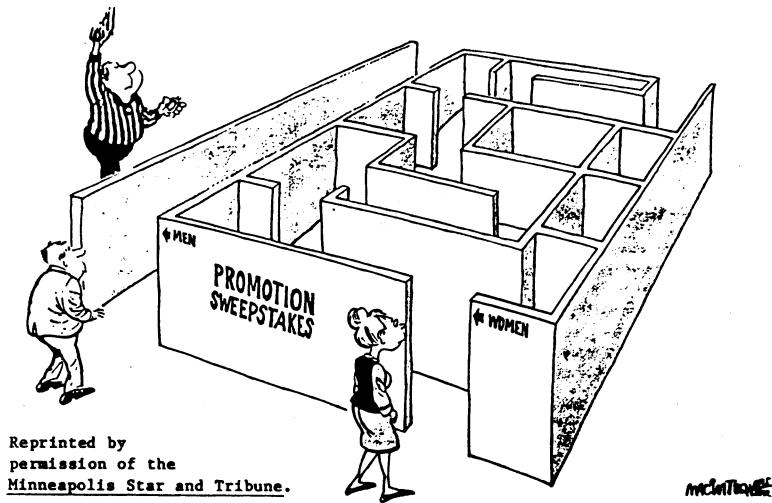
Career	% of People Trained for Career Who Find Jobs In That Career	Job Duties	Education Needed	Salary Level	Chance for Advancing To Higher Level Jobs
I	25%	Work with people all the time	4 years of college	Low pay	Excellent
II	50%	Work at desk most of the time, with people a small amount	2 years of education beyond high school	Average pay	Fair
III	50%	Work at desk some of time, with people some of time	High school education	Low pay	Fair
IV	Almost 100%	Work at desk some of time, with people some of time	4 years of college	Average pay	Good
V	Almost 100%	Work at desk most of time, with people a small amount	3 years of education beyond high school	High pay	Excellent

1. Kim thinks that, of the five careers listed, Career II is the best one for her. Why might she think this?
 - E It would allow her the best chance of getting a job with the least amount of education.
 - * F It requires the least education to obtain a job with a salary which is not low.
 - G It would allow her the best chance of advancing to a higher-level job with the least amount of education.
 - H Career II has the highest pay of the desk jobs.

2. Paul does not want a job which requires him to spend most of his time working at a desk. He wants to be very sure of getting a job in the career for which he has been trained. He would not be satisfied with a low salary. Which career seems best for him?
 - A Career I
 - B Career III
 - * C Career IV
 - D Career V

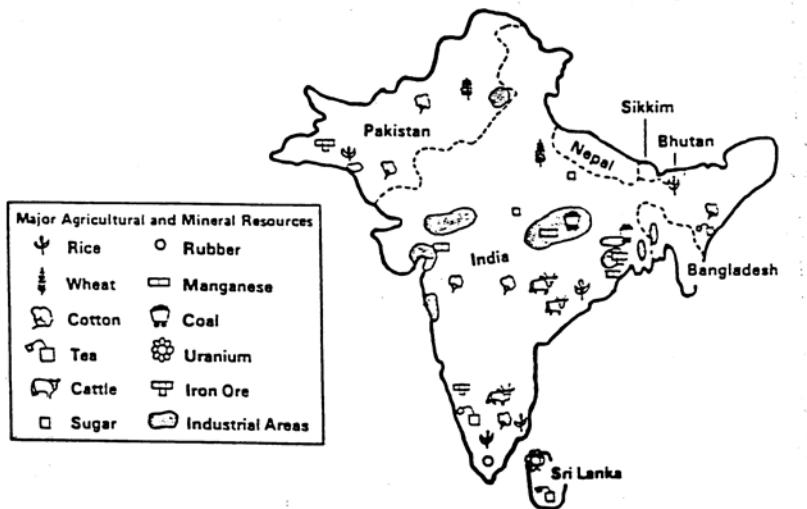
3. Sam has always wanted a job in which he spends most of his time working with people. What is the best question for him to ask about the information in the table?
 - E What kind of training would he need for Career II?
 - F How soon could he advance if he works in Career V?
 - * G If he is trained for Career I, what other jobs could he get?
 - H Why do people in Career II receive lower salaries than people in Career V?

Missimer (1987)



Which of the following statements BEST describes the main issue in this cartoon?

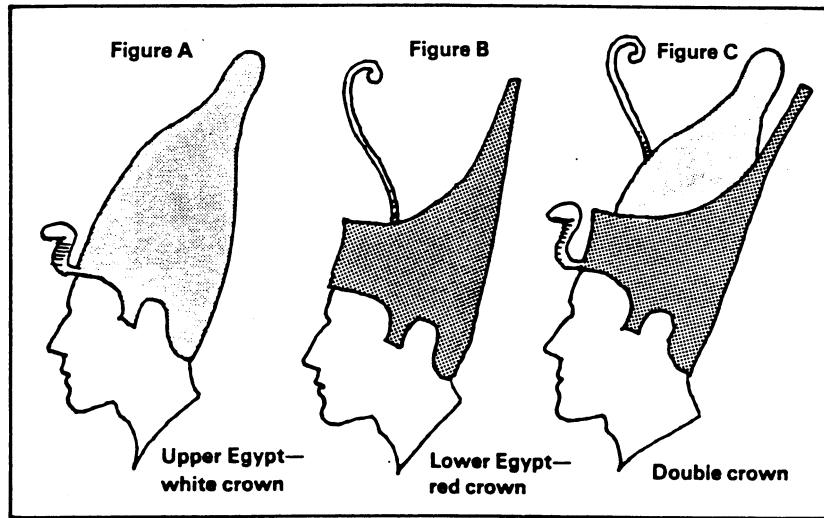
- *60 A. When it comes to promotional opportunities, there are more barriers for women than for men.
- 7 B. Promotional opportunities are about equal for men and women.
- 22 C. Men tend to be faster than women and get more promotions.
- 7 D. In the past, men got all the promotions, but now the situation has been reversed.



Which one of the following statements can be verified by the above map?

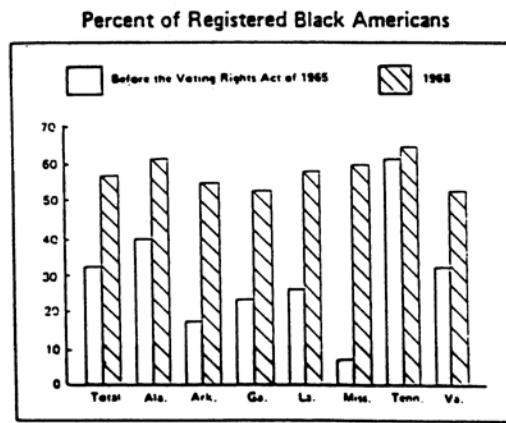
- 8 A. Pakistan produces more iron ore than does India.
- *59 B. Both India and Pakistan produce cotton.
- 14 C. India's population is greater than Pakistan's.
- 12 D. India has a more favorable climate for the production of cotton.

Kneedler (1988)



Special crowns identified ancient Egyptian kings called pharaohs. Figure A is the white crown of Upper Egypt; Figure B is the red crown of Lower Egypt. Look carefully at Figure C and select an appropriate question.

- *55 A. Did a pharaoh unite Upper and Lower Egypt into one kingdom?
- 9 B. How long did kings rule in ancient Egypt?
- 14 C. Did ancient Egypt ever have a woman ruler?
- 19 D. What is the longest period of time ruled by a king in Upper Egypt?

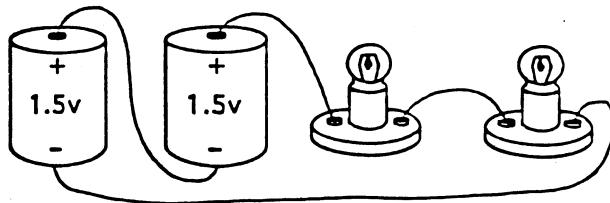


On the basis of the graph above, which of the following conclusions can you make about black American voters?

- *43 A. After the 1965 law, the number of black Americans registered to vote increased in every state listed.
- 13 B. Prior to the 1965 law, many black Americans had no interest in voting.
- 19 C. Only those states listed denied black Americans the right to vote.
- 26 D. The greatest increase in the black American voting population occurred in Tennessee.

Kneedler (1988)

Predict what will happen to the voltage, resistance, and current in the following circuit if each of the changes listed in the chart is made. Circle **INCREASE**, **DECREASE**, or **NO CHANGE**, in each box in the chart. Assume that the circuit is properly reconnected after a change is made.



What will happen if you	Voltage	Resistance	Current
add another bulb?	INCREASE DECREASE NO CHANGE	INCREASE DECREASE NO CHANGE	INCREASE DECREASE NO CHANGE
add a 9-volt battery?	INCREASE DECREASE NO CHANGE	INCREASE DECREASE NO CHANGE	INCREASE DECREASE NO CHANGE
remove one bulb?	INCREASE DECREASE NO CHANGE	INCREASE DECREASE NO CHANGE	INCREASE DECREASE NO CHANGE

Sugrue (1995)

Interpreting Data

**The question with
successful student
responses**

Joe, Sarah, José, Zabi, and Kim decided to hold their own Olympics after watching the Olympics on TV. They needed to decide what events to have at their Olympics. Joe and José wanted a weight lift and a frisbee toss event. Sarah, Zabi, and Kim thought running a race would be fun. The children decided to have all three events. They also decided to make each event of the same importance.

Joe, Sarah, José, Zabi, and Kim decided to hold their own Olympics after watching the Olympics on TV. They needed to decide what events to have at their Olympics. Joe and José wanted a weight lift and a frisbee toss event. Sarah, Zabi, and Kim thought running a race would be fun. The children decided to have all three events. They also decided to make each event of the same importance.

One day after school they held their Olympics. The children's parents were the judges and kept the children's scores on each of the events.

Child's Name	Frisbee Toss	Weight Lift	50-Yard Dash
Joe	40 yards	205 pounds	9.5 seconds
Jose	30 yards	170 pounds	8.0 seconds
Kim	45 yards	130 pounds	9.0 seconds
Sarah	28 yards	120 pounds	7.6 seconds
Zabi	48 yards	140 pounds	8.3 seconds

Record Finding (A) Who would be the all-around winner?

ZABI

(B) Explain how you decided who would be the all-around winner. Be sure to show all your work.

Account for Findings I wrote in order, all the scores from first place, to fifth place. Then I added them up. Whoever had the least amount, won.

They held their Olympics. The children's parents were the judges and kept the children's scores on each of the events.

Frisbee Toss	Weight Lift	50-Yard Dash
40 yards	205 pounds	9.5 seconds
30 yards	170 pounds	8.0 seconds
45 yards	130 pounds	9.0 seconds
28 yards	120 pounds	7.6 seconds
48 yards	140 pounds	8.3 seconds

Who would be the all-around winner?

Zabi

Explain how you decided who would be the all-around winner. Be sure to show all your work.

I numbered each event from 1-5 - the best score is 5. The worst is 1. Then I added the three scores for each of the children. Zabi's score is 11, which is the highest.

▲(Grade 11)

◀(Grade 7)

Educational Testing Service (1987)

PACKETS Times

Token Theft Puzzles the NY Police

New York—The New York Subway system is full of mysteries. Why do there always seem to be more trains going the other way? Why is the public address system just loud enough for you to hear, but never loud enough for you to understand? Why don't they use more trains during rush hour? And why do they call it "rush hour"? It's the most crowded, slowest, absolutely worst time of day to be traveling in a rush.

Yesterday the subway produced another mystery. How did a well-dressed couple persuade a token clerk to let them buy 12,000 tokens with a stolen check? The case has baffled transit officials.

According to police, the clerk received a telephone call from someone claiming to be a supervisor. The caller said that a man and a woman would come to the booth to buy \$16,000 worth of tokens. The tokens were for employees of a large company. The clerk should accept the check.

A few minutes later, another token clerk, Keith Lewis, came to the booth. He

asked to use the telephone there. While Lewis was on the phone, a man and woman dressed in business suits arrived. They presented the check to the clerk who had received the first call.

The clerk showed Lewis the check and asked if it looked valid. He told her that it did. She gave the couple all the tokens in the booth: \$13,800 worth, plus \$2,200 in cash, Mainly \$20 bills.

Mr. Lewis was arrested when the police learned the check was stolen. Police think the clerk who gave away the tokens and cash was an innocent victim.

Police did not say how the thieves carried such a large number of tokens out of the subway station. Did the couple get help carrying the 12,000 tokens away?

The transit authority rarely dispenses large amounts of tokens from subway booths. Customers who want to buy more than \$50 worth must get them from the authority's headquarters in Brooklyn. Detectives say they are close to more arrests in the case.

ACTIVITY

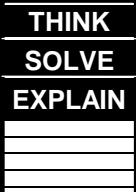
Million Dollar Getaway

Channel 1 News needs your help to check the facts in a story.

Main Bank was robbed this morning. A videotape from the security camera shows a lone person carrying the loot out of building in a big leather bag. The tellers agree that only one robber was involved. The bank manager says the robber got away with approximately one million dollars in small bills. Most of the bills were ones, fives and tens.

The editor for local news is wondering if all of this is possible. How difficult would it be for a single robber to carry so much money in small bills?

Analyze this situation to determine what might be possible. Present your results and conclusions in a report that will help the editor decide what to say about the robbery for tonight's broadcast.



A group of children were asked in which room of the house they prefer to do homework. The table below shows the number of children who prefer each room.

Room	Number of Children
Bedroom	330
Living Room	220
Kitchen	250
Dining Room	200

Using the data from the table above, complete the following in the answer book:

Part A On the grid, create a bar graph.

Part B Complete the circle graph.

Part C Determine which graph more clearly shows that more than half of the children prefer to study in the bedroom or the kitchen. Use the information from both graphs to justify your answer.

FCAT (1997)

Appendix C-7
Comparison of Problem-Solving and Information Literacy Tasks¹

Cluster 1: Problem-Solving Tasks ²	Cluster 2: Problem-Solving and Information Literacy Tasks ^{2,3}	Cluster 3: Information Literacy Tasks ^{2,3}
1. view reality; sense/reflect/recognize real problem—ALL AREAS	recognize the need for information—LIMITED TO NEED FOR INFORMATION	NOT TESTED IN CLUSTER 3—REFER TO CLUSTERS 1 AND 2
2. commit energy/motivation to solve/decide goals; self-talk/confidence, perseverance, flexibility—NOT TO BE TESTED	NOT TO BE TESTED	NOT TO BE TESTED
3. define problem/purposes/assumptions/puzzling, ambiguous facts/success criteria—internal/external (real world)—ALL AREAS; CF. #24	define/refine information problem; develop a research question or perspective on a topic identify types and amount of information needed; develop a research question or perspective on a topic—INFORMATION PROBLEM ONLY	identify problems related to access or use of e-mail, on-line discussion, desktop conferencing—EXECUTION AND ACCESS TASKS ONLY
4. NOT TESTED IN CLUSTER 1—REFER TO CLUSTERS 2 AND 3	identify/infer from relevant/irrelevant/sufficient information—FOR VARIETY OF COMPLEX, REAL-LIFE PROBLEMS	reject non-relevant information; select relevant information—FOR INFORMATION NEEDS
5. recall concepts/structures/solutions/facts/rules/procedures—ALL AREAS	NOT TESTED IN CLUSTER 2—REFER TO CLUSTERS 1 AND 3	recall computer resources/technologies and library media resources; recall legal and ethical conduct, policies, telecomputing etiquette for electronic technologies, conferencing, e-mail, discussion groups, newsgroups, listservs, and others
6. plan/match tools/strategies/knowledge; identify/organize steps/questions to view/solve/monitor self/progress—ALL AREAS	NOT TESTED IN CLUSTER 2—REFER TO CLUSTERS 1 AND 3	assess the value of electronic resources/data for the information need in relation to the information task; develop a plan for searching; identify references/information available through different types of computer resources and library media centers
7. search facts/expertise/issues/context/group mind/circumstances—ALL AREAS	NOT TESTED IN CLUSTER 2—REFER TO CLUSTERS 1 AND 3	locate and use electronic resources/technologies (catalogs, indexes, full-text sources, multimedia stations, CD-ROMs, software, scanners, digital cameras, newsgroups, listservs, WWW sites via browsers, gopher, ftps sites, databases, encyclopedias, dictionaries, biographical sources, atlases, databanks, thesauri, almanacs, fact books, experts/help/referral services, self-initiated surveys)
8. select/gather/organize/interpret information/perspectives; observe effects of concepts/rules; use rules—ALL AREAS	select/gather/organize/interpret information/perspectives—FOR VARIETY OF COMPLEX, REAL-LIFE PROBLEMS	use the internet for e-mail and on-line discussion; use groupware software; use desktop conferencing, e-mail, computer brainstorming or idea generating software; predict impact of compliance/noncompliance with legal, ethical, and etiquette telecomputing protocols
9. analyze information/patterns/parts/values/subarguments—ALL AREAS	SAME—FOR INFORMATION PROBLEM ONLY	NOT TESTED IN CLUSTER 3—REFER TO CLUSTERS 1 AND 2

Comparison of Problem-Solving and Information Literacy Tasks (continued)

Cluster 1: Problem-Solving Tasks ²	Cluster 2: Problem-Solving and Information Literacy Tasks ^{2,3}	Cluster 3: Information Literacy Tasks ^{2,3}
10. find elements/relationships/good, bad ideas/interests/span of factors/assumptions/values—ALL AREAS	SAME—FOR INFORMATION PROBLEM ONLY	NOT TO BE TESTED IN CLUSTER 3—REFER TO CLUSTER 2
11. use constraints to reduce problem/solution space—ALL AREAS	NOT TO BE TESTED IN CLUSTER 2—REFER TO CLUSTERS 1 AND 3	select from possible electronic information sources, the ones that are accessible and most likely to provide the type of information needed within the time and resources
12. NOT TESTED IN CLUSTER 1—REFER TO CLUSTER 2	keep open mind when gathering/analyzing information	NOT TESTED IN CLUSTER 3—REFER TO CLUSTER 2
13. explore ideas/outside structures; think broadly of all important factors/relationships/people/possibilities—ALL AREAS	NOT TO BE TESTED IN CLUSTER 2—REFER TO CLUSTERS 1 AND 3	think broadly of all important topics, resources, references, tools, technologies ⁴
14. identify instances of concepts; use labels/outlines/graphs/tables/logic/math/musical/visual symbols—ALL AREAS, CF. #15	identify charts, tables, graphs, databases, overheads, slides that appropriately present information	generate charts, tables, graphs, databases, overheads, slides; use spreadsheets, databases, and statistical software to process and analyze statistical data
15. organize/simplify/focus/classify/group/categorize/sequence/synthesize situations/relationships/facts; find central ideas—ALL AREAS, CF. #14	organize and communicate results of information search for integrated text and visual presentation of information	use electronic organizational systems, tools, and commands; create electronic spreadsheets, computer-generated graphics, and art for various print and electronic presentations; create WWW pages and sites; use spell and grammar check tools
16. summarize/integrate key elements/arguments—ALL AREAS	SAME	NOT TO BE TESTED IN CLUSTER 3—REFER TO CLUSTERS 1 AND 2
17. compare/contrast; apply whole-part-whole/cause-effect/similarities/other connections/see errors—ALL AREAS	SAME	NOT TO BE TESTED IN CLUSTER 3—REFER TO CLUSTERS 1 AND 2
18. recall/use deductive/inductive reasoning; identify errors/stereotypes/clichés/prejudices/opinions—ALL AREAS	SAME	NOT TO BE TESTED IN CLUSTER 3—REFER TO CLUSTERS 1 AND 2
19. recast/restructure/compare problem/solution/information—analogy/model/paradigm/schemata—ALL AREAS	SAME	NOT TO BE TESTED IN CLUSTER 3—REFER TO CLUSTERS 1 AND 2
20. NOT TO BE TESTED IN CLUSTER 1—REFER TO CLUSTERS 2 AND 3	recognize fact/opinion/true/false/agreement/disagreement; evidence/support/conclusion—ALL AREAS	NOT TO BE TESTED IN CLUSTER 3—REFER TO CLUSTERS 1 AND 2
21. recognize ambiguities, when to avoid/tolerate/estimate—ALL AREAS	SAME	NOT TO BE TESTED IN CLUSTER 3—REFER TO CLUSTER 2
22. recognize/analyze interpretations/perspectives/emotions/ego motives/power plays/traditions—ALL AREAS	SAME	NOT TO BE TESTED IN CLUSTER 3—REFER TO CLUSTER 2
23. use team skills/ways to settle conflicts—ALL AREAS	NOT TO BE TESTED IN CLUSTER 2—REFER TO CLUSTERS 1 AND 3	use e-mail, on-line discussion groups, and groupware software to communicate/discuss/survey/brainstorm with others

Comparison of Problem-Solving and Information Literacy Tasks (continued)

Cluster 1: Problem-Solving Tasks ²	Cluster 2: Problem-Solving and Information Literacy Tasks ^{2,3}	Cluster 3: Information Literacy Tasks ^{2,3}
24. form hypotheses/conclusions; generalize; predict/forecast alternative short/long-term consequences/implications—ALL AREAS, CF. #3	SAME	NOT TO BE TESTED IN CLUSTER 3—REFER TO CLUSTERS 1 AND 2
25. select/use internal/external criteria; evaluate/judge—ALL AREAS	evaluate content and format of information presentations—ALL AREAS	NOT TO BE TESTED IN CLUSTER 3—REFER TO CLUSTERS 1 AND 2
26. estimate risks/trade-offs; judge/set priorities—ALL AREAS	NOT TO BE TESTED IN CLUSTER 2—REFER TO CLUSTERS 1 AND 3	determine priorities for information seeking
27. express ideas about solutions, problems; explain reasoning—ALL AREAS	NOT TO BE TESTED IN CLUSTER 2—REFER TO CLUSTERS 1 AND 3	express ideas about search strategies, resources, technologies; explain reasoning behind choices
28. decide/select/reject; blend values/logic/information; defend—ALL AREAS, CF. #27	NOT TO BE TESTED IN CLUSTER 2—REFER TO CLUSTERS 1 AND 3	defend choice of sources and format of presentation
29. generate/identify (new) alternatives/choices—ALL AREAS	NOT TO BE TESTED IN CLUSTER 2—REFER TO CLUSTER 1	NOT TO BE TESTED IN CLUSTER 3—REFER TO CLUSTER 1
30. choose how/test solutions/hypotheses/conclusions; implement /revise/plan/multi-step procedures; recover from failure—ALL AREAS	NOT TO BE TESTED IN CLUSTER 2—REFER TO CLUSTERS 1 AND 3	select steps for implementing search and collecting/extracting/presenting information; backup files and recover from computer shutdown/failure
31. solve within time limits; rapidly execute subskills—ALL AREAS	NOT TO BE TESTED IN CLUSTER 2—REFER TO CLUSTERS 1 AND 3	extract/record/cut and paste information; cite, and credit electronic information rapidly execute subskills such as operating hardware and software, using keyboard, access codes, data entry and retrieval operations, menus, control keys, drives

¹ Variety of complex problems requiring the application of various academic skills appropriate for the grade level.

² Problem-solving tasks, which include some information literacy tasks are identified in Appendix C-3 as well as the complete reference list for this report.

³ Information literacy tasks are identified from the review of the “Big Six” skills in Doyle, 1994; Eisenberg & Berkowitz, 1988; Eisenberg, Johnson, & Berkowitz, 1996.

⁴ Tasks listed in italics are inferred from the explanations of the “Big Six” information literacy skills.