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The DISCOVER Project: Improving Assessment and Curriculum for Diverse Gifted Learners

C. June Maker
The University of Arizona
Tucson, Arizona

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The DISCOVER Project: Improving Assessment and Curriculum for Diverse Gifted Learners

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ABSTRACT

C. June Maker, Professor at the University of Arizona, has developed a unique performance-based assessment in which children are observed by teams of teachers, counselors, paraprofessionals, administrators, specialists in education of the gifted and bilingual education, and local community members. The assessment, designed initially to increase the participation of students from diverse groups in programs for the gifted, was later expanded to include the identification of the strengths of all children so their positive traits could be recognized and developed. This assessment and the corresponding model for designing appropriate curriculum and instruction to meet the needs of diverse groups are consistent with research in cognitive science and an emerging paradigm in the field of education of the gifted. These approaches are based on the theories and research of Stephen Ceci, Howard Gardner, and Robert Sternberg and represent Maker's synthesis during 16 years of research and development through the Discovering Intellectual Strengths and Capabilities (DISCOVER) Projects. Maker is extending this work by integrating it with the work of educators in Europe and Asia, and has developed a new classification of human abilities based on her research.

In this monograph, an Introduction provides readers with a context for the framework Maker has developed. She cites research from cognitive science, psychology, cultural anthropology, education of the gifted, and bilingual education—and combines this with personal experiences in teaching and studying in the field—to support ideas for changes needed to improve programs for gifted students from culturally, linguistically, economically, and geographically diverse backgrounds. In the second section, "Setting the Stage," in a personal way, she describes her own thinking and research process as the framework evolved and was tested. The assessment and curriculum models are described briefly in this section and results of research on their use and effectiveness are presented in a readable style. Following the "Setting the Stage" section is a descriptive account of the assessment, along with many ways the curriculum principles of DISCOVER can be implemented in general classrooms or classrooms for gifted students. This is the "Practical Applications" section, and in it she continues with real examples by presenting six case studies of schools, school districts, a state, and two other countries using the models. She concludes the practical applications section by presenting the new framework developed with colleagues in Europe and Asia.

The "Conclusion" is a synthesis of ideas; and here Maker presents specific, clear recommendations for policy-makers, coordinators, principals, and teachers interested in using her ideas and research. Additional resources are listed in this section, and practical

materials to assist various audiences and practitioners are included in the Appendices: an annotated bibliography of publications about DISCOVER (Appendix A), correlations between DISCOVER activities at different grade levels (Appendix B), an interview format to use with teachers instead of written forms for rating student characteristics and making referrals (Appendix C), suggested activities for teachers to use to provide a setting for observing children's problem solving in different ability areas (Appendix D), checklists of observable characteristics to use with these activities (Appendix E), and three teaching units based on the DISCOVER Curriculum principles (Appendices F, G, and H).

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EXECUTIVE SUMMARY

The world we have created is a product of our thinking;
it cannot be changed without changing our thinking.—Albert Einstein

Need for Changes in Beliefs

For over a century, educators have limited their beliefs about intelligence and superior abilities to research and theories from psychology, particularly from the research on "individual differences" even though this research has mainly been conducted on groups, especially those from advantaged and mainstream cultural backgrounds, with generalizations made based on averages and "standard" deviations rather than individual behavior (Ceci, 1996; Nielson, 1994). Ideas, results of empirical research, and theories from cultural anthropology, sociology, genetics, neuroscience, developmental psychology, education, and the new field of cognitive science must be integrated into our thought systems to form a more complete view of the multifaceted, multidimensional phenomenon we call giftedness.

A New Framework: From Theory to Practice

The primary goal of the research described in this monograph has been to transfer theory and research into classrooms and communities by designing an assessment and curriculum model integrating the theoretical frameworks proposed by Ceci, Sternberg, (1997, 1999, 2002), and Gardner (1983, 1994), which are excellent examples of integrated perspectives. According to Ceci, a prerequisite for cognitively complex behavior in a given realm is the possession of a well differentiated yet integrated knowledge base that gets operated on by efficient cognitive processes: "The knowledge and beliefs we possess in a specific domain . . . provide the raw materials for the operation of various cognitive processes during moments of problem solving. . ." (1996, p. 22).

To make Ceci's, Sternberg's, and Gardner's ideas applicable in education and easily understandable to teachers, work on defining levels of content enabling students to see how facts and experiences are connected to "big ideas" (Maker, 1982; Maker & Nielson, 1995) was integrated with the early work of psychologist Mihalyi

Csikszentmihalyi (Getzels & Csikszentmihalyi, 1967, 1976). Shirley Schiever and C. June Maker elaborated and extended this work to create a continuum of problem types that could be used to design assessments and curricula.

The framework of DISCOVER was designed to create a better alignment between the definition of problem solving, its assessment, and its development in an educational context. In Csikszentmihalyi's early research, the ability (and willingness) to structure an open-ended or ill-structured problem, or "problem-finding," as it was later labeled, was the single trait that most accurately predicted the later creative achievements of artists. This research had a significant effect on the field of education for gifted students, leading to the development of numerous teaching models in which problem-finding was valued over the solving of already-defined problems or problems with known solutions (Gallagher, Stepien, & Rosenthal, 1992; Maker & Nielson, 1995). Using the DISCOVER Model, assessments and curricula include a balance of all types of problems, and incorporate all levels of content—from data to concepts, principles, and theories.

Since the publication of Maker's first books on curriculum design and teaching (Maker, 1981, 1982), she advocated the design of learning environments for gifted students that are learner centered, knowledge centered, assessment centered, and community centered (Bransford, Brown, & Cocking, 2000). Discovering Strengths and Capabilities while Observing Varied Ethnic Responses (DISCOVER) was created to extend these principles and practices into schools with high concentrations of culturally and linguistically diverse, geographically isolated, and low income students—helping administrators, teachers, parents, and communities to adopt a "strength-based" instead of "deficit-based" view of students (Maker, 1993, 2001; Maker & King, 1996; Maker, Nielson, & Rogers, 1994; Maker, Rogers, Nielson, & Bauerle, 1996).

The purpose of this monograph is to present one model for eliminating barriers and increasing facilitators in both identification and the design of curriculum and instruction for students from groups traditionally underrepresented in programs for the gifted. The monograph is not intended as a review of several approaches or a comparison of similar and different methods, but rather as an in-depth presentation of DISCOVER. The definition of giftedness used in the DISCOVER framework is consistent with Stephen Ceci's Bioecological Theory of Cognitive Complexity (1996) and Sternberg's and Gardner's theories of intelligence. Observation is presented as an important basis for decision-making across assessment and curricular contexts and consistent with these theories. The author discusses the evolution of her ideas beginning with the study of gifted individuals with disabilities to designing assessment and curriculum models based on Gardner's Theory of Multiple Intelligences and Sternberg's Triarchic Theory, and finally, to rethinking and re-examining these assessment and curriculum models as a result of over 16 years of research.

Barriers and Facilitators: Assessment and Curriculum

Test makers and publishers continue to insist their instruments have no bias—yet those who score at the highest levels do not include equitable numbers of children from culturally and linguistically diverse groups, and programs for gifted students continue to be dominated by those from mainstream, middle and upper socioeconomic environments and backgrounds (Coleman & Gallagher, 1995; Ford & Harmon, 2001; Hunsaker, 1994; Gardner, 1995; Maker, 1996). A definite problem exists with the use of these instruments and the practices associated with them (Clasen, Middleton, & Connell, 1994; Cummins, 1984, 1991; Ford & Harmon, 2001). New instruments and procedures must be created, used, and tested.

Since intelligence and giftedness are complex constructs, and our world is in a constant state of change, programs and curricula also must be multi-dimensional and complex. Frameworks for program and curriculum development, as well as the practices that result, must be reframed so they are consistent with new beliefs, recent research, and new identification procedures. If learning is viewed as a transformation of an individual's knowledge and experiences rather than as an accumulation of new knowledge and experience, practices will be consistent with the latest information about how people learn (Bransford et al., 2000), and will be more culturally responsive to the changing faces of the children included in these programs.

The traditional and emerging paradigms (thought systems), that guide practice and research in education of the gifted, (Feldman, 1993; Treffinger, 1991) are quite different, and can be examined both to gain an important perspective on the reasons why certain groups have continued to be underrepresented in special programs and to generate alternatives with the potential to change this national problem. In the traditional paradigm, giftedness is seen as equal to a high IQ, stable and unchangeable, identified based on psychological tests, elitist in orientation, authoritarian or "top-down," school-oriented, ethnocentric, and expresses itself without special intervention. In the emerging paradigm, giftedness is perceived as having multiple forms, being developmental and process-oriented, based on performance, collaborative at all levels, and field-oriented. Excellence rather than elitism is the focus, diversity is central to its mission, and the context in which giftedness is assessed and developed is crucial to its expression. The traditional paradigm includes many barriers to the identification and provision of appropriate services for children from diverse groups, and examining this perspective carefully can help educators understand why certain groups remain underrepresented in special programs for the gifted. The emerging paradigm includes many facilitators—beliefs and practices that can help in identifying and providing appropriate services for underrepresented groups—so DISCOVER was designed from the viewpoint of the emerging paradigm. The aim of the teams of researchers and practitioners (Maker, 1996) was to minimize barriers and increase facilitators both for identification and programming.

The DISCOVER Assessment

A fundamental belief in the equal distribution of abilities across diverse groups led to the creation of the DISCOVER Assessment. The author believed that an emphasis on problem solving would be an important way to access the abilities of students from "at risk" populations. When testing a student's knowledge, often we are assessing exposure, not the ability to learn the information. The ability to learn the information is the key. Producing sophisticated products also is influenced by exposure to ways of organizing and presenting information. Emphasis on use of effective strategies has the potential to "level the playing field," enabling students who solve problems on a daily basis to demonstrate their abilities. "Little Claudia," a 5-year-old Mexican American girl, who was responsible for dressing her 2-year-old brother and making sure he was taken to daycare before she went to kindergarten class, had extensive practice in problem solving. However, she was not exposed to advanced knowledge through visits to museums or a home environment with many sources of information, nor was she given opportunities to produce sophisticated products through special courses, lessons, or other opportunities afforded to children from middle and upper socioeconomic status (SES) families. Many children from diverse economic, geographic, and cultural groups face challenges similar to Little Claudia's. Research on the DISCOVER assessment is showing that, without lowering standards or changing criteria, when DISCOVER is used to identify gifted and talented students, the ethnic, economic, and linguistic balance in the identified groups parallels the balance of these groups in the community (Maker, 1997; Nielson, 1994; Powers, 2003; Reid, Udall, Romanoff, & Algozzine, 1999).

Repeated assessments, revisions, feedback, and on-going data collection have resulted in a set of activities for each of four grade levels (K-2, 3-5, 6-8, 9-12), standardized procedures and directions, a behavior checklist to provide consistency in evaluations, and a "debriefing" process for increasing interrater reliability. Assessments are conducted in the familiar classroom environment. The students' teachers are the facilitators. The observers who assess children are other general classroom teachers; specialists in education of the gifted, bilingual education, or special education; preservice educators; counselors; community members; administrators; and other experts. Students, in groups of 4 to 5 peers, are encouraged to interact and meet the challenges presented. Bilingual observers and teachers present instructions and interact with children in the dominant language(s) of the students.

The DISCOVER assessment, however, cannot be separated from curriculum and teaching strategies, especially when they are designed to be interdependent. After a DISCOVER assessment is completed, administrators, teachers, parents (and the students themselves, especially at the high school level) receive information about the students' strengths (inter-individual and intra-individual) across the domains assessed, as well as very detailed reports of the problem solving behaviors observed during each activity. Problem solving behaviors are reported for each domain, core competencies within each domain, and for creativity and task commitment clusters. Teachers, parents, and students are assisted in the process of planning ways to build on student strengths as well as to compensate for weaknesses.

The DISCOVER Curriculum Model

In the DISCOVER Model "at-risk" students are viewed as being "at-promise" for success due to their problem solving strengths in diverse cognitive domains. When students' strengths are identified and teaching approaches developed so that strengths are used as vehicles for developing academic and real-life skills, students from all groups, including those considered to be "at-risk" experience greater success in school (Maker, 1992; Maker et al., 1996). Children and their teachers and caregivers develop more positive and realistic beliefs about their potential to succeed. When academic skills are taught within the context of real-world problem solving, these academic skills take on new meaning, and students perceive them as relevant.

A consistent message of school reform efforts is that students in America's schools must learn to think and solve problems rather than memorize facts and mindlessly apply algorithms. (National Academy of Sciences [NAS], 1996; National Council of Teachers of Mathematics [NCTM], 2000; President's Committee of Advisors on Science and Technology Panel on Educational Technology [PCAST-PET], 1997). A second consistent message is that a "constructivist" (rather than a "reductionist") approach is the most effective way to achieve the new national standards, and that certain key elements characterize this approach: (a) actively building new knowledge from experience and prior knowledge; (b) acquisition of higher-order thinking and problem-solving skills; (c) basic skills learned while undertaking higher-level, "real-world" tasks whose execution requires the integration of a number of skills; (d) information resources available to be accessed by the student at that point in time when they actually become useful in executing the task at hand; (e) fewer topics covered and explored in greater depth; and (f) students as active "architects" rather than passive recipients of knowledge (NAS, 1996; NCTM, 2000; PCAST-PET, 1997).

The DISCOVER curriculum is based on a constructivist philosophy, and involves using the principles of a good program for gifted students to enhance the learning and raise the standards for all students. Curricula and teaching strategies for gifted students are characterized by (a) integrated, interdisciplinary content; (b) higher-order thinking, appropriate pacing, self-directed learning, and complex problem solving processes; (c) development of unique products for real audiences; and (d) student interaction, interaction with experts, and learning environments with physical and psychological flexibility, openness, and safety. The environment is rich in resources, and the teacher usually acts as a guide rather than a dispenser of knowledge as the students make choices based on interest and ability (Maker, 1981, 1982; Maker & King, 1996; Maker & Nielson, 1995, 1996). These principles advocated for gifted programs characterize successful bilingual education programs (Cummins, 1984; Nieto, 1996; Ramirez, 1991; Tharp, 1989), effective schools (Heckman, 1996; Weissbourd, 1996), and early childhood programs incorporating developmentally appropriate practices (Bredkamp & Rosegrant, 1995; Maker & King, 1996). In addition to these principles, the DISCOVER curriculum model includes two other elements to broaden its applicability to students with diverse backgrounds and personal traits, including types of abilities. These two important

elements are (a) arts integration, especially visual arts, music, creative dance/movement, and theater arts; and (b) development of a wide range of problem solving abilities.

Conclusion and Recommendations

In the final section of the monograph, recommendations are presented for Policy-Makers; Program Coordinators for Special Education, Bilingual Education, and Education of Gifted Students; Principals; and Teachers. For example, Policy-Makers are urged to implement pilot programs in which the progress (success in the program or in regular classrooms) of students identified by various instruments is monitored, analyze these data, and report the results to others using or considering these instruments. Program Coordinators are asked to include many types of screening and referral procedures (such as performance-based measures like DISCOVER) to supplement teacher referral as a first step in deciding which children to test or examine further. An example of a recommendation for Principals is to interview or find other ways to elicit teacher statements or information to identify the beliefs of teachers, determine whether their views are consistent with the traditional or emerging paradigm, and initiate discussions and study groups to examine consistencies or discrepancies, and devise ways to resolve discrepancies. Teachers are urged to try the DISCOVER curriculum approach regardless of whether the school district implements the assessment.

In the appendices to the report, many practical materials are provided to help understand and implement the ideas and models presented in this monograph: an annotated bibliography of publications about DISCOVER for those who want to read the research in more depth or get additional ideas for implementation (Appendix A), correlations between DISCOVER activities at different grade levels to help researchers and psychologists interested in intercorrelations across studies (Appendix B), an interview format for coordinators and specialists to use with classroom teachers instead of written forms for rating student characteristics and making referrals (Appendix C), suggested activities and characteristics for classroom teachers to use when observing and identifying children's problem solving in different ability areas (Appendix D), checklists of observable general problem solving characteristics to use with activities such as those in Appendix D (Appendix E), and three teaching units based on the DISCOVER Curriculum principles (Appendices F, G, and H). Another resource is the DISCOVER web page at www.discover.arizona.edu and the information from the web can be used to contact the DISCOVER team of professionals to gather more information or request other resources listed on the web site.

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The world we have created is a product of our thinking;
it cannot be changed without changing our thinking.—Albert Einstein

PART 1: Introduction

How is a theory developed? How is a lens crafted? How is a framework framed? How do beliefs evolve? And then, most importantly, how do these frameworks, theories, lenses, and beliefs inform and shape our behavior? All these are important questions educators must consider as they try to choose or design instruments and practices—and go about the incredibly complex task of understanding, inspiring, and challenging our most precious human resource: our children with natural gifts and talents. Theories, frameworks, and the lenses through which we see children and ourselves evolve through application of thinking processes (some logical, some perhaps not following any logical pattern) and methods we have learned through experience and academic studies, and they are based on the consistency of these methods with our beliefs. And, of course, most of us realize—most of the time—that these beliefs also have evolved through a combination of experiences and academic studies. Beliefs have formed through a complex interaction of geographical environment, cultural and social setting, language conventions and limitations, and other factors such as economic opportunities—and they began to form long before we, as young individuals, were able to recognize that we were forming important ideas that would shape our entire lives! Often, we have difficulty articulating our core beliefs, and certainly find their source(s) hard to pinpoint.

When my colleagues and I were interviewing teachers during the DISCOVER III Project, we found that we couldn't ask teachers a direct question about their beliefs regarding giftedness or the ways children should be taught. In response to these questions, we heard many things that did not seem to us to be beliefs—practices, examples of student reactions, a quote from someone else, a description of a class they had taken, for example. We had to ask the teachers to identify some children they thought were gifted and describe their behaviors, then ask questions about why the teachers viewed certain children as gifted, and what the behavior they described told them about the child's abilities. Think about it sometime. Try to identify your core beliefs about gifted people. What do you believe? What has been the evolution of your beliefs? How did your early experiences with other children influence your ideas? How did your academic studies play a role? What about your major professor or advisor—how did her or his thinking influence yours? What books did you read, and how did they shape your thinking? How does your perception of yourself influence your beliefs about other people's abilities?

A Need for Changes in Beliefs

Several years ago, I began to be concerned about the fact that most of the theories and research that had shaped the field of education for the gifted came from psychological research and an orientation toward abilities coming from this singular, therefore narrow, perspective. Starting with Alfred Binet and following in that tradition, particularly with Lewis Terman, psychologists designed tests of speed, accuracy, or specific cognitive processes, tried them on many individuals, and developed "norms" or generalizations based on the level of performance of a cross-section of people of certain ages or those possessing other traits deemed important. In this tradition, general statements and principles are derived from analysis of the group's performance, and individual performance is judged by comparison with the averages and standard deviations of scores of either the total group or sub-categories of the group. "What other way is there?" some might be thinking. Sociologists and anthropologists, on the other hand, study behavior of individuals and groups by *observing them in their natural settings*, and take into account as many characteristics of the place, time, other people, and individual traits as possible. General statements and principles are derived from analysis of the behavior of individuals *within a particular context*. The environment and the interactions in it are especially important and relevant to any interpretations of individual and group behavior. In the last few decades, advances in technology development have enabled us to study the structural aspects of human brains, and to relate an individual's behavior to her or his neurological traits as well as to the characteristics we can observe with our five senses.

Key scientific findings about human learning and problem solving in recent decades have come from studies of people who have developed expertise, and who have achieved eminence in areas such as science and math (Chase & Simon, 1973; Chi, Feltovich, & Glaser, 1981; Chi, Glaser & Farr, 1988; Getzels & Csikszentmihalyi, 1976; Glaser, 1992; Pinker, 1997; Sternberg, 1999). Studies of experts indicate that their thinking is organized around patterns, principles, or big ideas when they solve scientific problems, whereas novices tend to perceive problem solving as recalling and manipulating equations to get answers (Larkin, 1983, Larkin & Simon, 1987). When asked to state an approach to solving a problem, expert physicists usually discuss general principles before jumping to formulas or equations. Novices, in contrast, tend to discuss specific equations (Chi et al., 1981).

Also influenced strongly by this research on the development of expertise, Ceci (1996) proposes a Bioecological theory of "cognitive complexity" that encompasses and goes beyond popular "contextualist" theories of intelligence and intellectual development (e.g., Gardner, 1983, 1999; Sternberg, 1997, 1999). By integrating research from cognitive science, cultural anthropology, experimental psychology, sociology, genetics, developmental psychology, and education, Ceci provides a framework for understanding how learner traits, genetic makeup, home and community environments, culture, and language interact in a child's development. Use of his theory provides a framework for integration of research-based curriculum, instruction, and assessment models in educational settings (National Research Council, 1999).

A New Framework: From Theory to Practice

The primary goal of my research has been to transfer theory and research into classrooms and communities by designing an assessment and curriculum model integrating the theoretical frameworks proposed by Ceci (1996), Sternberg (1997, 1999), and Gardner (1983, 1999). According to Ceci, a prerequisite for cognitively complex behavior in a given realm is the possession of a well differentiated yet integrated knowledge base that gets operated on by efficient cognitive processes: "The knowledge and beliefs we possess in a specific domain . . . provide the raw materials for the operation of various cognitive processes during moments of problem solving. . ." (1996, p. 22). Working closely with schools, teachers, parents, and policy-makers, my colleagues and I have applied principles guiding education for gifted students in general classrooms to enhance the education of all students, helping them to reach national and international standards of excellence (Maker, 2001). To make Ceci's, Sternberg's, and Gardner's ideas applicable in education and easily understandable to teachers, my work on defining levels of content enabling students to see how facts and experiences are connected to "big ideas" was integrated with the early work of psychologist Mihalyi Csikszentmihalyi (Getzels & Csikszentmihalyi, 1967, 1976). Shirley Schiever and I elaborated and extended this work to create a continuum of problem types to design assessments and curricula.

In this continuum (Maker & Schiever, in press; Schiever & Maker 1991), problem-solving situations are classified according to what extent the individual who presents the problem (usually the teacher) or the person who solves the problem (usually the student) knows the problem, method for solving the problem, and the solution. In other words, the continuum is based on the amount of information or structure in the problem situation presented. Types I and II are well-structured, requiring mostly convergent thinking, and students must reach the correct or best solution determined by the teacher or author of the test being given. Problem types at the other end of the continuum (Types V and VI) are open-ended and unstructured; they require a balance of divergent and convergent thinking and the problem solvers have to decide the best or correct solution from their own perspectives. Types III and IV, in the middle of the continuum, provide a transition so that both teachers and students can move from the familiar structured learning and teaching situations to more ambiguous and often unfamiliar ones. Assessments and curricula should include a balance of all these types of problems, and must incorporate all levels of content—from data to concepts, principles, and theories.

Since the publication of my first books on curriculum design and teaching (Maker, 1981, 1982), I have advocated the design of learning environments for gifted students that are learner centered, knowledge centered, assessment centered, and community centered (Bransford, Brown, & Cocking, 2000). Discovering Strengths and Capabilities while Observing Varied Ethnic Responses (DISCOVER) was created to extend these principles and practices into schools with high concentrations of culturally and linguistically diverse, geographically isolated, and low income students—helping administrators, teachers, parents, and communities to adopt a "strength-based" instead of

"deficit-based" view of students (Maker, 1993, 2001; in press; Maker & King, 1996; Maker, Nielson, & Rogers, 1994; Maker, Rogers, Nielson, & Bauerle, 1996).

For over a century, most educators have limited their beliefs about intelligence and superior abilities to research and theories from psychology, particularly from the research on "individual differences" even though this research has mainly been conducted on groups, especially those from advantaged and mainstream cultural backgrounds, with generalizations made based on averages and "standard" deviations rather than individual behavior (Ceci, 1996; Nielson, 1994). We have entered a new era, and other important fields must no longer be ignored. Ideas, research results, and theories from cultural anthropology, sociology, genetics, neuroscience, developmental psychology, education, and the new field of cognitive science have been integrated into the thought system behind the development of DISCOVER to enable educators to form a more complete view of the construct we call giftedness, and to develop better ways to meet the needs of an increasingly more diverse student population.

In this monograph, I (a) examine barriers and facilitators in both identification and the design of curriculum and instruction for students from groups traditionally underrepresented in programs for the gifted; (b) suggest a framework for viewing giftedness that is consistent with Stephen Ceci's Bioecological Theory of Cognitive Complexity (1996) and Sternberg's and Gardner's theories of intelligence; (c) introduce observation as an important basis for decision-making across assessment and curricular contexts; and (d) discuss the evolution of my ideas from the study of gifted individuals with disabilities to the design of assessment and curriculum models based on Gardner's Theory of Multiple Intelligences and Sternberg's Triarchic Theory, and finally, to a rethinking and re-examination of these assessment and curriculum models as a result of over 16 years of research.

Barriers and Facilitators: Assessment

Test makers and publishers continue to insist their instruments have no bias—yet those who score at the highest levels do not include equitable numbers of children from culturally and linguistically diverse groups, and programs for gifted students continue to be dominated by those from mainstream, middle, and upper socioeconomic environments and backgrounds (Coleman & Gallagher, 1995; Ford & Harmon, 2001; Gardner, 1995; Hunsaker, 1994; Maker, 1996). A definite problem exists with the use of these instruments and the practices associated with them (Clasen, Middleton, & Connell, 1994; Cummins, 1985, 1986, 1991; Ford & Harmon, 2001). New instruments and procedures must be created, used, and tested. Unfortunately, in the current climate of high-stakes testing, very little support is being provided for such innovative efforts. I believe that when new instruments are based on a wholistic, natural framework, we will find that many problems associated with the use of many older, outdated instruments will disappear!

In this part, I briefly introduce some of the problems with assessment of students from economically, culturally and linguistically diverse backgrounds, and prepare for the

discussions of research and presentation of the DISCOVER performance-based assessment that will follow in the "Setting the Stage" section. A review of literature, including both data-based research and professional opinions, combined with personal experiences with students in the Southwestern U.S. as well as experiences with students and professionals from other countries, was used to create a chart showing the factors that can prevent (barriers) and increase (facilitators) the identification of students from underrepresented groups. These are summarized in Table 1, and are discussed in the following sections.

Table 1

Barriers and Facilitators in Identification of Gifted Students From Culturally, Linguistically, and Economically Diverse Backgrounds

Barriers	Facilitators
1. Beliefs about giftedness	1. Beliefs about giftedness
2. Educational practices based on the traditional paradigm of beliefs	2. Educational practices based on the emerging paradigm of beliefs
3. Lack of engagement in tests	3. Active engagement in problem solving tasks
4. Acceptable responses to linguistic tasks limited to surface features of language	4. Acceptable responses to linguistic tasks include underlying features of language
5. Items/tasks with complex verbal instructions to measure non-verbal abilities	5. (a) Concrete materials to measure non-verbal abilities (b) Simple and/or pantomimed instructions for activities measuring non-verbal abilities
6. Using checklists of characteristics based on research with high IQ students	6. Using checklists of characteristics from research on competent performance
7. One type of task to measure "general intelligence"	7. Varied tasks to assess varied abilities
8. Tasks or questions with one right answer	8. Tasks with varied ranges of acceptable responses

Beliefs

As I attempt to show in the discussion of how my own beliefs developed (later in the "Setting the Stage" section of this monograph), what educators believe about

giftedness has a profound and pervasive effect on the numbers and percentages of students from diverse groups they identify as gifted. According to Feldman (1993) and Treffinger (1991), the field of education for the gifted is in a state of transition from the traditional paradigm or way of thinking about giftedness to an emerging paradigm. Feldman and Treffinger's views on the differences in the ways of thinking in the field are quite similar: In the traditional view, giftedness is equal to a high IQ, stable and unchangeable, identified based on psychological tests, elitist in orientation, authoritarian or "top-down," school-oriented, ethnocentric, and expresses itself without special intervention. In the emerging paradigm, giftedness is seen as having multiple forms, being developmental and process-oriented, based on performance, collaborative at all levels, and field-oriented. Excellence rather than elitism is the focus, diversity is central to its mission, and the context in which giftedness is assessed and developed is crucial. If educators truly believe in the emerging paradigm, identification of gifted students from underrepresented groups will be possible; and if their practices are consistent with this belief system, identification of these students will not only be possible, but also will no longer be a national problem! When beliefs shift to this new perspective, new practices will be designed and supported, traditional instruments and practices will be used appropriately, funding will be available, and people will be easier to convince of the necessity of re-directing resources to enable changes in the existing structure of programs and services. Let's look, then, at what practices are consistent with the traditional and the emerging paradigms.

Educational Practices

Assessment, teaching and other educational practices that result from the traditional paradigm are *barriers* to identification of students from underrepresented groups, and those that result from the emerging paradigm are *facilitators* of their identification. The most significant aspect of this view, from my vantage point, is to equate giftedness with a high IQ. Although a high IQ can be an indicator of giftedness, a low IQ is not necessarily an indication that a student is not gifted. Many examples can be provided that show how individuals with even lower than average IQs can perform in ways we recognize as definitive of giftedness. All the individuals I describe in the "Setting the Stage" section of this monograph as having a profound influence on me had average or low IQ scores, and were served in a way consistent with this evaluation. In addition, one only has to review the test scores of a group of students from underrepresented groups to know that on most individually and group-administered tests, they score several points lower than their peers from advantaged, English-speaking, mainstream cultural backgrounds (Baker, Abedi, Linn, & Niemi, 1996; Ford & Harmon, 2001). At the state and local policy level, this means that high cut-off scores on IQ tests must no longer be used as the most important (or only) criterion for determining whether a student is eligible for special services (Sarouphim, 2002).

I am not suggesting that we eliminate IQ tests, nor am I saying they do not have a place in the identification and referral process (see Gottfredson, 2004, for a review of IQ tests and their advantages in identification of gifted students; and see Ceci, 1996; Perkins, 1995; Gardner, 1992; and Sternberg, 1997 for discussions of the limitations of IQ

testing.). The important point to remember is that if IQ tests occupy the *central* place, and are used as the most important or only indicator of giftedness, we will continue to see programs dominated by children from advantaged, English-speaking, mainstream cultural backgrounds (see Baker et al., 1996; Ford & Harmon, 2001).

Another belief within the traditional paradigm that has a significant impact on the identification of students from diverse backgrounds is viewing giftedness or abilities as stable and unchangeable. This is an outmoded and outdated belief. New research in many fields shows the malleability of abilities, and the responsiveness of individuals, including older adults, to an enriched environment (Ericsson & Charness, 1994; Ericsson, Krampe & Tesch-Romer, 1993; Maker, 1992; Perkins, 1995; Perkins & Salomon, 1989). An orientation toward "school success" or academic proficiency as the only indicator of ability also inhibits identification of students from underrepresented groups, as they often lack certain valued learning opportunities provided at home or in the community to their more advantaged peers, and thus must play "catch-up" throughout their educational careers (NAEP, 2000; National Center for Educational Statistics [NCES] 2000a, 2000b, 2001a; National Science Foundation [NSF], 2003; Yamauchi & Tharp, 1995). Many lose interest and motivation as they are constantly viewed, or see themselves, as less competent than their classmates (Antell, 1980; Yamauchi & Tharp, 1995).

When multiple forms of giftedness are recognized, multiple measures are employed; when performance is the valued indicator of giftedness, and when context is viewed as crucial, educators and psychologists rely on observation of students as they participate in a variety of learning activities, solve problems and tasks that are meaningful to them, and succeed in out-of-school contexts—rather than accepting only a test score as the indicator that a student is competent or gifted. Practices based on recognition of multiple forms of giftedness result in the identification of a higher percentage of students from culturally, linguistically, and economically diverse groups as gifted (Borland & Wright, 1994; Clasen et al., 1994; Powers, 2003; Reid, Udall, Romanoff, & Algozzine, 1999; Sarouphim, 2001; VanTassel-Baska, Johnson, & Avery, 2002).

Engagement

Clearly, if students are not engaged in a task or test, they will not demonstrate their giftedness! However, this fact often goes unnoticed by educators with limited views of how students perform or those with little experience with diverse students. I have watched many children take tests that were meaningless to them, and have watched them search for meaning and interest until they were so totally frustrated and disillusioned that they simply "gave up" and started to act out or doodle. As we gave students from a small, rural Navajo school the *Developing Cognitive Abilities Test* several years ago, I remember many of the children asking me who or what "golf" was as they attempted to solve math problems about golf games. I tried to explain something about the game, but they had no reference point, nor did it help them to have an abstract idea of the game. If basketball had been the example, we would have had no problem at all! When children who have learned from observing their elders or from making their own errors, or who

are "hands-on" learners, are expected to demonstrate their competence by filling in blanks or "bubble-sheets," engagement is low.

What if the words and the pictures in an item don't match? This is a common experience for students with high spatial analytical abilities and low reading skills. In these cases, the task has no intrinsic motivation, the child has no tangible reason for doing well on it, and the result often is a low score. Also, think how motivated and engaged you would be to do your best on a test in which you didn't understand what you were supposed to do or one in which you could only read a few words of each question! Even worse, think of the frustration if you were asked to think analytically or conceptually at a high level, and then express these complex concepts in a language you understood only at a concrete level. This is the typical experience of children who take tests in English when they have not become proficient in academic English, a process that takes second-language learners from 5 to 7 years (Cummins, 1986; Yamauchi & Tharp, 1995). This frustration also is typical for second-language learners who can speak English, but have not learned to read it, a process that also takes several years in a second language. Lack of engagement is not limited to traditional tests, but is a concern with any assessment.

Acceptable Responses to Linguistic Tasks

When the answers we accept are limited to the surface features (Cummins, 1984, 1986) of language—grammar, syntax, vocabulary—we penalize students whose first language is not English, or those who come from environments with language models who did not speak Standard English. This latter group includes not only children from African American backgrounds but also those from the rural areas of Appalachia and even the farm country where I grew up! Vocabulary tests, writing samples, synonym and antonym tests, and verbal analogies all are influenced by this barrier. As with engagement, these problems are not limited to traditional tests, but can be a factor in any assessment.

If, however, the underlying (Cummins, 1984, 1986) features of language—its use to communicate, entertain, describe, and convince—are the emphasis in assessment of the quality of responses, children with high linguistic capabilities from diverse language environments can emerge and demonstrate their competence (Pellegrino, Chudowsky, & Glaser, 2001). One example is for another native speaker to observe students in their home settings or other comfortable environments where they are free to use their natural language. Another way to include the underlying features of language is to observe children as they learn to speak or write English, and attend to learning rate as well as the ways children speak to or interact with peers from similar backgrounds. In a more formal assessment situation, analysis of both correct usage and mistakes can provide clues to a child's competence. The strategy of "miscue" analysis developed by Kenneth and Yetta Goodman at the University of Arizona (Goodman, 1969, 1984) is an excellent example of a well-developed and researched method for analyzing children's mistakes as a way to find out what language skills they possess. For instance, invented spelling can show whether a child understands the sound-symbol connection in writing. My favorite

example is from a story written by a second-grade Navajo child who was just learning English. She spelled "laughed" "laft." I have always thought it should be spelled that way, and that if we were to change some of our spelling conventions, people would have a lot less trouble learning our language! The point is, however, that her invented spelling showed she was making a direct, clear connection between the sounds and the letters used to symbolize those sounds. Instruments used to measure the cognitive abilities of English Language Learners (ELL) must be designed to assess these underlying features rather than relying on the child's accuracy and skill in using English.

Complex Verbal Instructions Used to Measure Non-verbal Abilities

The use of complex written or spoken instructions to explain tasks designed to measure non-verbal abilities penalizes both students who are not fluent speakers and readers of English, and students who have high visual/spatial abilities and low linguistic abilities. Not only does the practice of using complex verbal instructions not make sense on a practical level, but it also has no theoretical validity! Several factors come into play here. A student may not understand the task at all, so does not attempt it even though he could do it if he knew what was required. Another student may understand the task or item if given plenty of time to read slowly and look carefully at the visual cues, but will not be able to complete very many items before time is called. As the Committee on the Foundations of Assessment sponsored by the National Academy of Research (Pellegrino et al., 2001) have emphasized, in a testing situation, we must minimize extraneous factors—factors that are not relevant to the construct or skill we intend to measure. When a high level of reading ability or verbal comprehension in English is required for understanding an item measuring non-verbal ability, the task or test has a significant extraneous factor.

Unfortunately, another problem with many items and tasks used to measure students' abilities is that the verbal instructions and the picture or diagram are not consistent. When the diagram or picture is incorrect or misleading, but the verbal instructions are clear, a child with good verbal skills and low visual/spatial abilities is not distracted or confused, and does well on the item. On the other hand, the child with high visual/spatial skills and low English language skills is confused or distracted, and often misses or leaves out the item. An example from a well-known and often-used paper and pencil measure of intelligence is an item in which students are to tell how many corners a person will turn as she walks around a city block, starting in front of her home. The diagram does not have a completed block. It stops at one corner, and the child who is pictured coming out of the house could be turning one "corner" just to get on the sidewalk that leads around the block! Using only the verbal instructions, a student can guess the correct answer, especially if she has experience with city blocks. However, for children who rely on visual cues and attend to the diagram, especially those not from a city, the item is totally confusing, and most miss it.

On the other hand, using very simple instructions and items with consistent formats can facilitate the identification of non-verbal abilities of children from non-English-speaking or non-Standard English-speaking backgrounds, or children with high

visual/spatial skills. Another facilitator is to demonstrate or mime the instructions, and to give practice items until assured the student understands the task. Providing instructions in the child's dominant language helps as well, but keep in mind that some children do not have a dominant language. We found, for example, that many children on the edges of the Navajo reservation had parents who spoke some English and grandparents (with whom they spent much of their time) who spoke Navajo. These children often watched a lot of television (usually cartoons or action-packed visual movies) in English. Seldom did they speak either Navajo or English fluently. Mexican American children living in Spanish-dominant neighborhoods in the city of Tucson are in a similar situation.

Finally, an important facilitator is the use of concrete materials, manipulatives, and other hands-on tasks to measure non-verbal abilities. Not only are these tasks and materials a more pure measure of non-verbal intelligence, but they also are much more engaging and interesting to the students. I am reminded of this fact every time I see a student completing the Block Design subtest of the Wechsler Scales or begging me to let her keep the bag of Tangrams and the puzzles we asked her to work!

Checklists of Characteristics

A common aid to the identification of students who are gifted is a checklist given to the classroom teacher as a first-level screening to determine who will be tested or considered further for a possible place in a program for the gifted. Many checklists in use are based on the research of Lewis Terman (1916; 1925) conducted almost 100 years ago. Are gifted students still the same? Perhaps yes, perhaps no, but they certainly live in a different world now! Some checklists used to guide teachers' referrals are barriers and some are facilitators. When the checklists used are based on research on students with high IQs, often students from culturally, linguistically, and economically diverse backgrounds are penalized. Terman's studies, for example, included very few students from diverse backgrounds or low income families, and certainly was not a representative sample even in his day. After initial testing of students in a few "poorer schools" without finding children with an IQ greater than 140, Terman advised the field assistants to restrict the search to "better schools" in higher-class neighborhoods. Using these procedures, Terman and his assistants identified 643 children from 578 families, more than 99% White, in or near 5 cities in California (Terman, 1916, 1920; Terman, Kelly, & Ruch, 1923). Many IQ tests developed since the Stanford Binet are judged by their ability to produce similar results, and most are loaded heavily with linguistic items (Baker et al., 1996) since the traditional view of giftedness emphasizes language competence. Consider, for example, the items below:

- *Has unusually advanced vocabulary for age or grade level; uses terms in a meaningful way; has verbal behavior characterized by "richness" of expression, elaboration, and fluency.*
- Has rapid insight into cause-effect relationships; tries to discover the how and why of things; *asks many provocative questions (as distinct from informational or factual questions)*; wants to know what makes things (or people) "tick."

- Has a ready grasp of underlying principles and *can quickly make valid generalizations about events, people, and things.*
- Is a keen and alert observer; *usually "sees more" or "gets more" out of a story, film, etc., than others.*
- *Reads a great deal on his own; usually prefers adult level books; does not avoid difficult material; may show a preference for biography, autobiography, encyclopedias, and atlases.*

In italics are the aspects of each item that are troublesome for students from non-English-speaking families or environments in which Standard English is not the norm. In the first item, for instance, all the examples of the characteristic are dependent on a high facility with English, along with extensive experiences in practicing its use. In the second, rapid insight certainly isn't dependent on language facility, but being able to articulate these insights as generalizations does depend on linguistic ability. Reading, the last characteristic, is even more difficult for those learning a second language, and usually is learned after a speaking vocabulary is acquired.

Three other items not listed above are included on the checklist: one is related to the amount of information a child has acquired about varied topics, another to the rapid pace of mastery and recall, and the last characteristic deals with the child's attempt to understand complicated material through reasoning and being able to see logical and common sense answers. Thus, 5 of the 8 items penalize those without high proficiency in the English language. In essence, when a checklist such as this is used as a general screening to find students who may be gifted, teachers are given a silent message that children from diverse backgrounds do not fit the profile of a gifted student, and should not be referred for further study.

All of the above items are from a portion of a checklist entitled "Learning Characteristics," and all come from research on the characteristics distinguishing students who are gifted from those who are not. In these studies, however, giftedness was defined as having a high IQ (above 130). I see no problem with calling these traits "characteristics of linguistically gifted students from English-speaking, middle to upper socioeconomic classes, and mainstream cultural backgrounds." Those are, indeed, the characteristics of the groups of students studied. However, I do see a problem with applying them to students from culturally, linguistically, and economically diverse backgrounds (and, in fact, the authors caution us not to use them in that way!); and similarly, I see a problem with labeling them as general "learning characteristics" since they deal mainly with facility in language use rather than high competence in non-linguistic abilities such as visual/spatial, logical-mathematical, and musical.

From the perspective of the emerging paradigm, in which multiple forms of giftedness are recognized, the five traits listed above can form a significant portion of a checklist of linguistic competence. If adapted to reflect a recognition of the effect of context on the expression of giftedness (another element in the emerging paradigm), the checklist can be an aid to teachers as they attempt to identify students in their classrooms who may possibly be linguistically gifted. However, additional items would need to be

generated to supplement this list, and they should come from research on competent performance and observation of children with background characteristics similar to the characteristics of the targeted groups (e.g., Mexican American children from Spanish-speaking families, children from geographically isolated areas, children from economically disadvantaged homes). Further, other checklists are needed so that teachers can see how other forms of giftedness such as visual/spatial and logical-mathematical are expressed. Research in which checklists derived from observations of competent children from underrepresented groups are used to make decisions about giftedness has shown that teachers can recognize gifted students from these groups (Frasier et al., 1995; Sak & Maker, 2003a; Sarouphim, 2001; 2004).

For me, interviewing teachers has been a much more effective way to find out about the children in their classrooms, and I have developed and pilot tested a form and manual to use for this purpose (Appendix C). The essential question in this interview process is "Which student or students in your class are inquirers (e. g., Which student or students in your class show probing exploration, observation, or experimentation with events, objects, ideas, feelings, sounds, or media?) instead of "Which characteristics (out of a list of common characteristics of gifted students) do the children you believe are gifted exhibit?" The interviewer encourages teachers to think more broadly about all the students in the class, and to consider the strengths of all students in the class, not just the few they already have decided have high ability. When an interviewer asks about a characteristic, and is asked to tell which of the children in the class exhibit that characteristic, and the interview continues in this way, teachers are less likely to rate certain children high on every trait and others low on every one. In other words, their stereotypes and "haloes" are not as influential in their ratings. Another aspect of the interview process is that interviewers give teachers examples of the many ways each trait can be observed or demonstrated, encouraging teachers to consider spatial, bodily-kinesthetic, interpersonal, intrapersonal, musical, and naturalistic abilities rather than limiting their thinking to the more common linguistic and logical-mathematical expressions of ability.

Limited or Only One Type of Task to Measure "General Intelligence"

A common solution to the assessment of students from underrepresented groups is to administer a non-verbal test. The assumption usually made is that these non-verbal abilities are not influenced by culture, language, or economic conditions, or that they are less influenced by these conditions than are verbal abilities. In actuality, all abilities are influenced by environmental conditions (Ceci, 1996; Perkins, 1995). An additional problem is that non-verbal tests often have a limited number of types of tasks, and this limitation can penalize students who think differently from what is expected. A very clear example of these problems from my experience is with Navajo students on one section of the Standard Progressive Matrices (Raven, Raven, & Court, 1998), a test advocated (Sacuzzo, Johnson, & Guertin, 1994) as an alternative to the usual verbal or combination of verbal and non-verbal abilities tests. Certainly, Native American students often score higher on this test and others assessing non-verbal abilities than they do on measures of verbal ability, and they clearly have non-verbal (visual/spatial) strengths

(Yamauchi & Tharp, 1995). However, the Raven is not free of problems with this group of students, and other measures with only one type of item lack construct validity since non-verbal abilities are many and varied (Carroll, 1993; Gardner, 1993; Lohman, 1996).

In one of the first DISCOVER Projects, we administered the appropriate form of the Matrices to all students in our experimental and comparison classes—from Grades 1 through 11. We found that on the Coloured Progressive Matrices (Raven, Court, & Raven, 1977), a form in which students are required to find which pattern fits into an overall visual pattern, the students always scored appropriately—in other words, we found a reasonable range of scores, with some low, some average, and some high. We identified 3-5% as being gifted on this level of the test. However, with the Standard Progressive Matrices, the students scored appropriately on certain sections of the test, but always scored very low on one particular section. The intensity of the problem increased as the students became older, in that the high school students' scores were more depressed than the elementary or middle school students' scores. Students' performance on this section lowered their overall scores enough to prevent them from being identified as gifted.

We decided to interview a sample of students to try and determine what was causing this pattern. These young people were using a type of logic that came from their extensive experience and orientation to their own culture, rather than the logic used to construct the items. They found the items confusing, and said that in some cases, no "right" answer was available in the choices. In the problematic section, test-takers are required to examine an array of nine figures and determine which combination of figures fit the bottom right corner, which is left blank. The student is expected to examine the rows and columns, adding and subtracting elements to decide which ones are missing, and need to be included. However, what the students were doing was examining the overall pattern of the array, and expecting it to be constructed like the geometric patterns of rugs, sand paintings, and other symbols of their culture. In their geometric patterns, the center point, or focus of the array, is different, and the corners are the same. Other interesting patterns are added in the other places in the array, but are added consistently and with attention to design and interest. In the arrays they were examining, they could detect no overall visual pattern, so they guessed or simply left the items blank.

In short, completing the items correctly required the examinee to *attend to each visual element as a separate entity*, while the students' logical thinking processes required them to *attend to each visual element as part of the pattern of the whole*. In essence, these students were using what is described by many researchers as a "visual" or "wholistic" approach. A visual or wholistic, as opposed to a verbal, emphasis in perception and representational structures is one in which the pieces derive their meaning from the pattern of the whole. In verbal/analytic thought, the whole is revealed through the unfolding of the sections. "Wholistic comprehension proceeds by incorporating phenomena into ever-expanding circles of context, rather than by reducing phenomena to their dis-assembled parts" (Tharp, 1989, p. 353). Caucasian, Japanese, and Chinese students tend to employ verbal/analytic processes, while Hispanic and Native American students tend to employ visual/wholistic processes (Tharp, 1989; Yamauchi & Tharp,

1995). Use of a visual/wholistic process instead of a verbal/analytical process is an important aspect of the differential performance of students from Hispanic and Native American groups on a wide range of tests. This factor is equally important in alternative assessments and classroom performance.

An appropriate solution to the problem is to make certain a wide range of items are included to measure a construct as complex as non-verbal intelligence. Some test developers and researchers equate spatial ability with non-verbal intelligence. Others separate elements of non-verbal intelligence, and include spatial as one of several aspects of non-verbal ability. In the Wechsler scales, for instance, the Performance Subtest (non-verbal) includes subtests as diverse as Block Design, Object Assembly, Mazes, and Picture Completion. Even if spatial ability is the only aspect of non-verbal intelligence being assessed, it is complex. From the differential theory perspective (Lohman, 1996), for instance, spatial ability includes several factors: *visualization* (the ability to manipulate visual patterns successfully regardless of the speed of the task), *speeded rotation* (quickness in manipulating, transforming, and doing metal rotations), *closure speed* (quickness in identifying a novel visual pattern), *closure flexibility* (speed in finding, apprehending and identifying disguised visual patterns), and *perceptual speed* (quickness in finding a known pattern or accurately comparing one or more patterns). From the cognitive psychology point of view, spatial ability includes three major processes: encoding, transformation, and reproduction of visual images. Carroll (1993), from this perspective, defines spatial ability as "an ability in manipulating visual patterns as indicated by level of difficulty and complexity in visual stimulus materials that can be handled successfully, without regard to the speed of task solution" (p. 362). Lohman (1996) defines spatial ability as "the ability to generate, retain, retrieve, and transform visual images" (p. 98). However, when Lohman defined factors, he emphasized the speed of generating, retaining, retrieving, and transforming. Carroll's definition emphasizes outcomes and products regardless of processing speed, while Lohman's definition emphasizes cognitive processes and functions. In Gardner's view of spatial intelligence, both cognitive processes and their outcomes are important in assessing spatial abilities. He defined spatial intelligence as "the capacity to perceive the visual world accurately, to perform transformations and modifications upon one's initial perceptions, and to be able to re-create aspects of one's visual experience" (1983, p. 173). Both internal processes and outcomes are reflected in Gardner's definition. So, the point to be emphasized here is that a variety of processes and outcomes must be assessed if one is to make valid conclusions about an individual's "non-verbal" intelligence.

Number of Responses Accepted

A significant barrier in the identification of students from culturally, linguistically, and economically diverse groups is the common use of tests or tasks with only one correct answer or one acceptable way of responding or solving a problem. The usual reason for this practice is that the tests or tasks are easier to evaluate and score, and thus have higher reliability (consistency). However, this practice results in penalties for those who think differently (many gifted and creative children) and those who come from an experiential background different from the usual mainstream perspective. I will never

forget the distress of a kindergarten teacher from a school in an impoverished area when I arrived to observe her classroom after she had completed the school readiness tests she was required to administer. She knew that her students were competent enough to begin first grade. However, many of them did not score high enough on the tests because their responses to the questions did not fit the acceptable answers. Here is one example she gave: "Peanut butter comes in a _____." The students were supposed to fill in the blank. Most of her children responded "can." Indeed, this was correct. The children received government "commodities" in which peanut butter was delivered in a large tin can. Some of her children responded "sandwich," which also was correct because their mothers made them peanut butter sandwiches to take to school, and they weren't allowed to make the sandwiches themselves. However, neither of these responses could be counted correct when scoring the test. Only "jar" was an acceptable answer. This is only one of many, many examples I can give of the biases inherent in this common practice of limiting acceptable responses to one correct answer or procedure. Not only do we form an inaccurate picture of the child's learning ability, but we also miss a golden opportunity to *find out what the child does know*, *not just what he does not know*!

When more than one response is considered acceptable, and when tasks are deliberately constructed to find out how many responses a student can generate, we not only get a more complete picture of his knowledge, but we also can find out what processes she is employing to generate these answers. E. Paul Torrance's (1973, 1976) extensive work with creativity assessment, and his absolute certainty that "differences are not deficits," and that children from different cultures and economic groups are not impoverished thinkers is the most prevalent example of the use of such items in our field. However, we have called this assessment of creativity rather than assessment of intelligence. I believe we can use this type of item to assess not only general creativity but also intellectual strengths and *academic* knowledge and skills. Consider the responses of two children to the two types of questions in mathematics. Both girls are in the second semester of second grade, and the exams were given in March, within 2 weeks of each other. Both children are from a similar background—same ethnicity, same home language—and both are from low income families.

Felicia

Solve these problems.
4 + 7 = 11; 9 – 3 = 6; 12 – 7 = 5; 20 + 40 = 60; 32 – 11 = 21; 48 + 51 = 99; 6 + 4 = 10
Use these numbers to write correct addition or subtraction problems.

2	5	3	2 – 5 = 3
9	1	8	9 – 1 = 8
4	3	7	4 + 3 = 7
12	2	10	12 – 2 = 10

Write as many problems as possible that have 10 as the answer. You may use the back of this page.
5 + 5 = 10 6 + 4 = 10 8 + 2 = 10 9 + 1 = 10 7 + 3 = 10 10 + 0 = 10

Krystal

Solve these problems.

4 + 7 = 11; 9 – 3 = 6; 12 – 7 = 5; 20 + 40 = 60; 32 – 11 = 43; 48 + 51 = 99; 6 + 4 = 10

Use these numbers to write correct addition or subtraction problems.

2	5	3	2 + 3 = 5	3 + 2 = 5	5 – 3 = 5	5 – 2 = 3
9	1	8	1 + 8 = 9	8 + 1 = 9	9 – 8 = 1	9 – 1 = 8
4	3	7	4 + 3 = 7	3 + 4 = 7	7 – 4 = 3	7 – 3 = 4
12	2	10	10 + 2 = 12	2 + 10 = 12	12 – 10 = 2	12 – 2 = 10

Write as many problems as possible that have 10 as the answer. You may use the back of this page.

1 + 9 = 10	7 + 3 = 10	13 – 3 = 10	19 – 9 = 10	100 – 90 = 10
2 + 8 = 10	8 + 2 = 10	14 – 4 = 10	20 – 10 = 10	
3 + 7 = 10	9 + 1 = 10	15 – 5 = 10	21 – 11 = 10	
4 + 6 = 10	10 + 0 = 10	16 – 6 = 10	22 – 12 = 10	
5 + 5 = 10	11 – 1 = 10	17 – 7 = 10	23 – 13 = 10	
6 + 4 = 10	12 – 2 = 10	18 – 8 = 10	24 – 14 = 10	

If we only used the first set of problems, those with one correct answer, we might consider Felicia slightly better in math than Krystal since all her answers were correct, and Krystal missed one problem. Both would be seen as having similar skills. However, examining their responses to the second set of problems yields a different picture. Felicia doesn't yet show her understanding of the importance of sequence or order in subtraction (the first example is not correct), nor does she show an understanding of reversibility in addition. However, Krystal does. She generates all possible solutions for all four combinations of numbers, and all are correct.

When examining the third set of problems, we can see very different levels of mathematical understanding (and perhaps motivation and interest as well). Felicia wrote six problems, all correct. She demonstrated an understanding of the property of zero, but all other problems were simple combinations of one-digit numbers. Krystal, on the other hand, presented all combinations of one-digit numbers, and again demonstrated her understanding of reversibility. She also showed an understanding of the properties of zero. She used subtraction, and seemed to understand that she could continue indefinitely as long as she continued to go up the number scale. At the end, she showed that she could also include three-digit numbers. Perhaps most importantly, however, she demonstrated the use of a logical strategy for generating her examples. She started with the number 1 and continued to 24! Perhaps she decided at this point that she could do this all day, and it was time to go on to another type of problem. Regardless of what we might infer about her thinking when she stopped at the number 24, we can see that she showed a much higher level of mathematical ability than Felicia, but we would not have known this on the basis of only the first set of problems. Similar results have been found across diverse domains of ability (Maker, 1993, 2001).

Summary

In summary, then, in this section, I outlined and described some of the major barriers to the identification of children from culturally, linguistically, and economically diverse groups who are gifted—students who are usually underrepresented in special programs emphasizing talent development and nurturing of giftedness. These barriers and facilitators are found in both traditional and alternative assessments, and must be considered in the selection and use of any method to identify gifted students from the targeted groups. Educators can increase the number of facilitators and reduce the number and impact of the barriers using the examples of ways each facilitator can be employed during the usual processes of screening, testing, and decision-making. In the following section, I describe barriers and facilitators important in curriculum design and instruction.

Barriers and Facilitators: Curriculum

Since intelligence and giftedness are complex phenomena, and our world is in a constant state of change, programs and curricula also must be multi-dimensional and complex. Frameworks for program and curriculum development, as well as the practices that result, must be reframed so they are consistent with new beliefs, recent research, and new identification procedures. If we view learning as a transformation of an individual's knowledge and experiences rather than as an accumulation of new knowledge and experience, our practices will be consistent with the latest information about how people learn (Bransford et al., 2000), and will be more culturally responsive to the changing faces of the children we include in our programs.

In this section, I review the beliefs coming from the traditional paradigm and the beliefs stemming from the emerging paradigm; and show how these beliefs result in educational practices that are either detrimental (*barriers*) or helpful (*facilitators*) for the design of curriculum and instruction appropriate for students from culturally, linguistically, and economically diverse groups. In a way similar to the preceding section, a review of literature, including both data-based research and professional opinions, combined with personal experiences with students in the Southwestern U.S. as well as experiences with students and professionals from other countries, is used in explanations of these two barriers and facilitators. They are presented in Table 2, and are discussed in the following sections.

Table 2

Barriers and Facilitators for Curriculum Design and Instruction of Gifted Students From Culturally, Linguistically, and Economically Diverse Backgrounds

Barriers	**Facilitators**
1. Beliefs about giftedness	1. Beliefs about giftedness
2. Educational practices based on the traditional paradigm of beliefs • Giftedness is Equal to a High IQ • Ethnocentric • Giftedness Expresses Itself Without Intervention	2. Educational practices based on the emerging paradigm of beliefs • Multiple Forms of Giftedness • Diversity Is Central to the Mission • The Context Is Crucial to the Expression of Giftedness

Beliefs

Just as our beliefs about giftedness can be barriers or facilitators to finding children who are gifted and who are from culturally, linguistically, and economically diverse backgrounds, they can be barriers or facilitators in the design of curriculum and instruction in special programs for those who are identified. In the section on assessment, I outlined the traditional paradigm or way of thinking about giftedness and described its detrimental effects on identification of students from underrepresented groups. Here, I will show how these traditional beliefs impact curriculum and instruction, and show how beliefs from the perspective of the emerging paradigm can facilitate the provision of appropriate curriculum and instruction.

Let's look again at the elements of the traditional paradigm: giftedness is equal to a high IQ, stable and unchangeable, identified based on psychological tests, elitist in orientation, authoritarian or "top-down," school-oriented, ethnocentric, and expresses itself without special intervention. In the emerging paradigm, giftedness is seen as having multiple forms, being developmental and process-oriented, based on performance, collaborative at all levels, and field-oriented. Excellence rather than elitism is the focus, diversity is central to its mission, and the context in which giftedness is assessed and developed is crucial.

Interestingly, many of the elements in the traditional paradigm are the beliefs that we bemoan and fight as we attempt to convince policy-makers and administrators that a special program for especially able children is needed. If giftedness is stable and unchangeable, they always will be gifted, and we can continue to provide the same education we always have provided. If giftedness expresses itself without special intervention, why do we want to provide a special program? How many times have all of us heard "but the gifted can take care of themselves! They're already ahead of the rest of the students." Educators of the gifted often are accused of being "elitist" because of the

composition of programs—programs in which most of the students already have economic and academic advantages—and many current practices perpetuate this view of the field.

Within the field, perhaps the greatest barrier to the provision of appropriate curriculum and instruction for underrepresented students is an "ethnocentric" view. I remember clearly my heated discussions with a well-known leader in this field several years ago as I attempted to explain to him why I could not use the word "culturally disadvantaged" to describe the children from Mexican American, African American, and American Indian cultures and families in poverty areas, or Caucasian children from geographically isolated regions of the country! I tried to get him to understand that these students did have a culture, even though they didn't go to museums or art galleries, hadn't ever heard a symphony play, didn't have shelves full of books, and weren't familiar with a library. They did have a culture, but it was just *different* from his. Fortunately, the label "culturally disadvantaged" has disappeared from our vocabulary, but unfortunately, the beliefs that led to use of the terms have not disappeared. In fact, in discussions with teachers of regular and gifted students, I am continually struck by the fact that most American teachers value the same things this famous educator did, and see their children from certain groups as "culturally disadvantaged." Negative stereotypes have a detrimental effect on curriculum and instruction, leading to lower expectations and differential treatment, which ultimately impacts the students and produces the very results initially expected (Brophy, 1983; Good & Brophy, 1994; Tharp, 1989). The current push for "English-only" instruction stems from an ethnocentric view also, ignoring the advantages of bilingual instruction (Cummins, 1984, 1991) and the fact that the best schools in this country and most other countries routinely provide bilingual instruction.

When the emerging paradigm guides our thinking, diversity is central to the mission of the field: we search for diverse forms of giftedness, teach different points of view, strive to find students from different backgrounds, and do what we believe is necessary to keep them involved in special programs. From this viewpoint, giftedness needs nurturing—and the context in which it is developed and nurtured is particularly important. From this perspective, special programs for especially able children are not only tolerated, but also seen as essential. Since giftedness is seen as developmental and process-oriented, programs must be started early and maintained so the child's abilities unfold and are supported at all ages.

In the following sections, I chose the aspects of these paradigms that are most influential in helping or hindering educators and policy makers in their attempts to provide appropriate curriculum and instruction for underrepresented groups. Other beliefs also may have an impact, but perhaps are not as influential.

Educational Practices From Beliefs: Giftedness Is Equal to a High IQ vs. Multiple Forms

Educational practices resulting from the traditional paradigm are barriers to the provision of appropriate curricula and instruction for students from underrepresented

groups, and those resulting from the emerging paradigm are facilitators. Starting with the view of giftedness as equal to a high IQ, one can see how this belief could lead to provision of a "one-size-fits-all" curriculum for gifted students. Essentially, from this viewpoint, since IQ scores are based on the idea that one "general intelligence" exists and that certain abilities characterize those with high IQs, a curriculum addressing these general characteristics seems to be justified. Of course, it is also true that the same IQ score can be achieved with several completely different patterns of abilities, and that students with the same IQs can have quite different patterns of achievement across different academic areas (Ceci, 1996; Perkins, 1995). A common practice that is detrimental to students from underrepresented groups, stemming from this viewpoint, is identification based on a non-verbal test of intelligence with subsequent placement in a program based mainly on linguistic ability. Even more detrimental is to identify students using a test administered in a home language other than English and placing them in a program with gifted students whose primary language is English—and language is the main focus of the program. Students are placed in a program not matched to their abilities and characteristics, they fail or do not do as well as the other students, so teachers conclude that they are not gifted, and the stereotypes of children from underrepresented groups are perpetuated.

When multiple forms of giftedness are recognized and valued, the pattern of abilities or the areas in which students were identified as gifted determine the program, curriculum, instruction, and services provided. For example, if a student is identified as gifted in linguistic ability, but not in math, he is placed in a language arts program, and really does not belong in the "gifted math" class even though that may be the only program available! Similarly, a child identified because of high academic achievement in math or science does not necessarily belong on the "Future Problem Solving Team." That child might be more appropriately placed in an accelerated math or science program. In this instance, the student was identified based on the ability to learn concepts rapidly, and to be successful in an academically based program, but is then placed in a program in which creative and divergent thinking are essential.

Educational Practices From Beliefs: Ethnocentric vs. Diversity Is Central to the Mission

Ethnocentric perspectives are barriers, while viewing diversity as a central concept in a program for gifted students is a facilitator. From an ethnocentric perspective, the curriculum and instruction for all gifted students are the same, regardless of the culture and language of the child, and are designed based on the values of the mainstream culture. The usual rationale for this perspective is that the students will need to be successful in the mainstream culture, and they need to get used to it as soon as possible! The main problem with this perspective is that to be successful, the children actually need to experience *both* mainstream cultural practices and those that are compatible with their own cultures. Children from Mexican American, American Indian, African American, and other "minority" or non-mainstream cultures are accustomed to certain practices, and they have learned habits and patterns before coming to school. These patterns and habits will continue to be reinforced and supported by their families and communities, so the

students will retain characteristics from their home culture as they *add* elements and understandings from the mainstream culture.

An extensive review of the research conducted during the past few decades on how people learn was commissioned by the National Research Council (Bransford, Brown, & Cocking, 2000). In the book published as a result of this review, authors emphasize the importance of a "learner-centered" environment, and define it as one in which careful attention is paid to the knowledge, skills, attitudes, and beliefs that learners bring to the educational setting. The term "learner-centered" includes practices that have been labeled "culturally responsive" and "culturally compatible" by researchers in education and cultural anthropology. Essentially, many researchers believe that the achievement gaps between students from Hispanic, Native American, and Caucasian cultural groups (NAEP, 2000; NCES, 2000a, 2000b; NSF, 2003); children whose home language is other than English and native speakers of English (Cummins, 1984); and children from low and high income groups (NCES, 2001b) result from a cultural "misfit" between the informal teaching and learning processes of students' home cultures and the formal teaching and learning of the typical classroom (McCarty, Wallace, Lynch, & Benally, 1991; Yamauchi & Tharp, 1995). Although cultures differ significantly, certain principles can be derived from research involving different groups that can be applied universally. Characteristics of the learner must inform instruction, and these traits vary individually as well as by culture.

Schools expect, and instructional practices usually assume, a certain pattern of cognitive functioning: a tendency toward verbal/analytic thought (Tharp, 1989; Tharp & Yamauchi, 1995). Students with these characteristic patterns of thought (e.g., Japanese, Chinese, and Caucasian), are more likely to succeed in school than those with visual/wholistic patterns (e.g., Hispanic and Native American). These patterns have been demonstrated in numerous studies of cross-cultural cognitive functioning (c.f., Maker, 1993; Tharp, 1989). A visual or wholistic, as opposed to a verbal, emphasis in perception and representational structures is one in which the pieces derive their meaning from the pattern of the whole. In verbal/analytic thought, the whole is revealed through the unfolding of the parts. "Wholistic comprehension proceeds by incorporating phenomena into ever-expanding circles of context, rather than by reducing phenomena to their dis-assembled parts" (Tharp, 1989, p. 353).

Interestingly, teaching that is responsive to the needs of Native American and Hispanic students also will be beneficial to all students, including those in special education, in their learning of content such as science and math. One example is the use of model-based reasoning (Lehrer & Romberg, 1996a, 1996b; Schauble, Glaser, Duschl, Schulze, & John, 1995). Modeling involves construction, evaluation, and revision of physical models, and is central to professional practice in many science and math disciplines, but is largely missing from school instruction. Models can be physical, but they also can be verbal, emphasizing how knowledge is hierarchical and connected (Maker & Schiever, in press). Constructing models can help students with a wholistic pattern of cognitive functioning connect the factual information being presented with the context and general principles that are important in expert performance. Expert

physicists, for example, generally discuss principles and procedures in their problem solving, while novices tend to discuss specific equations that could be used to manipulate variables in the problem (Chi et al., 1981). One example of the use of such a strategy is a computer-based tool that constrained students to perform a conceptual analysis of problems based on a hierarchy of principles and procedures (DuFresne, Gerace, Hardiman, & Mestre, 1992). Compared with students who solved problems on their own, students who used this program (a) performed better on measures of expertise, and (b) considered principles rather than surface features of problems more often when deciding how to solve problems.

Another example of ways to help students with a wholistic pattern of functioning to see connections is scaffolding using an apprenticeship model. In this approach to scaffolding, an expert practitioner first models the activity while the learner observes, gives advice and examples, then guides the learner in practice, and gradually withdraws support and guidance until the apprentice can do it alone (Collins, Brown, & Newman, 1989). This approach is very similar to the ways Native American parents and elders teach their children, and has demonstrated success in increasing their participation and engagement in learning (Yamauchi & Tharp, 1995).

The principles and practices described above are just as important in designing curriculum and providing instruction for gifted students as they are for all students. Educators must be responsive to the characteristics students bring with them to the learning environment. This responsiveness must include an understanding of the types and patterns of the students' abilities as well as their values, attitudes, experiences, and interests.

Educational Practices From Beliefs: Giftedness Expresses Itself Without Intervention vs. The Context Is Crucial

From the belief that giftedness expresses itself without intervention come attitudes that frustrate all of us, and lead policy-makers and administrators to eliminate special programs for gifted students or oppose their creation. This viewpoint is detrimental to all students, but especially for those from underrepresented groups. Often, they do not have opportunities for certain types of learning in their home and community environments that can make up for what they don't get at school—experiences that are common for students from advantaged homes or homes in which such opportunities are more highly valued. From the perspective that context is crucial to the expression and development of giftedness, again the research reviewed by Bransford and his colleagues is helpful (Bransford et al., 2000). They emphasize that an integral part of learning is the degree to which learning is relevant to students' everyday lives. A community-centered learning environment makes students' learning meaningful. The community-centered environment includes several aspects of community: the classroom as community (student communities); the school as a community (teacher communities); and the degree to which students, teachers, and administrators are connected to the broader community, including homes, community centers, after-school programs, community members,

experts, and scientists. What is learned in school should be connected to out-of-school learning.

Schools in which parents are meaningfully involved in the formal education of their children outperform schools without strong parent involvement programs. Children whose families are involved with the school earn higher grades and score better on tests, attend school more regularly, complete more homework assignments, graduate at higher rates, go on to higher education more frequently, and have more positive attitudes toward schooling than those with less-involved families (Ceci, 1996; Henderson, 1987). A contextualized, comprehensive approach to school-community integration is one that includes, but goes beyond parent involvement. It is mutually beneficial to the school and the community. Among many models of community-school partnerships, Miller & Hahn (1997) underscores the importance of the use of community as curriculum, emphasizing the community in all of its complexities as part of students' learning activities in the classroom.

A community-centered learning environment is particularly important for Hispanic and Native American students. This approach is synonymous with learning that is "contextualized" (Tharp, 1989; Yamauchi & Tharp, 1995). Teachers must demonstrate how rules, abstractions, and verbal descriptions are drawn from the everyday world and how they are applied again to it; and they must draw on personal, community-based experiences to provide the foundation for developing school skills (Tharp, 1989). Hispanic and Native American students (as well as their Caucasian peers) with a wholistic cognitive pattern will benefit from seeing how their local community concerns can be connected to the nation and other parts of the world (Maker, 2001). Technology can provide interesting ways to make these connections, bringing real-world problems into the classroom for students to solve and connecting them with practicing scientists (Barron et al., 1998) through programs such as Global Lab (Tinker & Berenfeld, 1993, 1994), the Jasper Woodbury Problem Solving Series (Cognition and Technology Group at Vanderbilt, 1997), and Project GLOBE (Lawless & Coppola, 1996; Means et al., 1997).

A community-centered approach also includes teachers and the "culture" of the school. The most effective teacher development activities are those that are extended over time, model the type of teaching being advocated (Becker & Riel, 2000; U.S. Department of Education, 2000) and encourage the development of teachers' learning communities by creating opportunities for shared experiences with both experts and peers (Gonzales, Pickett, Hupert, & Martin, 2002; McKenzie, 1999; Norton & Gonzales, 1998). Another important feature of teacher development programs is the emphasis on both disciplinary knowledge and pedagogical knowledge (Bransford et al., 2000). Expert teachers know the structure of their disciplines and this knowledge provides them with cognitive roadmaps that guide their teaching. That is, disciplinary content knowledge and pedagogical knowledge interact in effective teaching. Particularly, the following types of professional development activities have been found effective in improving teaching: (a) in-depth study in their content areas, (b) having pedagogical knowledge, (c) use of specific teaching methods, (d) use of technology, (e) observation of other teachers

teaching and (f) participation in long-term seminars, workshops or conferences (Darling-Hammond, 2000).

As the research presented in this section demonstrates, context is important for all learners, including teachers as learners. Many programs designed for gifted students include an emphasis on studying and connecting with the local, state, national, and international communities. We need to make certain these connections include the communities from which the students come, and not take them to the symphony without also taking them to the piñata shop in the Hispanic barrio!

Summary

If educators start from a belief in multiple forms of giftedness and the importance of collaboration and diversity, they will employ culturally compatible educational practices as diverse as the students themselves, which result in higher achievement and better performance of all students, and are especially influential for those from diverse backgrounds. Viewing the context in which giftedness is demonstrated as crucial to its expression will lead to changes in identification, curriculum, and instruction (e.g., DISCOVER, total school reform, and programs such as Schoolwide Enrichment [Renzulli & Reis, 1985]) aimed at increasing learning opportunities and challenging experiences for all students, or at least a larger pool of students, to enable more learners both to demonstrate their abilities and to have them nurtured and extended.

PART 2: Setting the Stage—A Little Theoretical and Research Background

A Brief History

Developing the Framework

Like many others in the field, I came from the psychological perspective. I was an elementary school teacher educated in the 1960s and early 1970s, and a teacher of the gifted soon after. I read all the classics in our field, paying special attention to the researchers and theorists my professors believed were important, such as Lewis Terman, E. Paul Torrance, R. L. Thorndike, L. L. Thurstone, J. P. Guilford, Raymond Cattell, and a few my professors never said anything about, such as W. R. Charlesworth, John Horn, and Lauren Resnick. Unlike many others, I also came from a rural background. I grew up on a farm in western Kentucky with a father who was an astute observer of nature. My dad could tell you the psychological and emotional characteristics of all his cows as well as their typical behavior when they had a new calf! He knew the terrain just by feeling the currents of air—their temperature, their direction, and their speed. He could always "scare up" a rabbit or a squirrel when we had company for dinner and there was no meat in the house.

Coming from this psychological background, my beliefs were somewhat typical of our field, until starting my own research. While working in the U.S. Office of Education, I had the opportunity to meet with some striking individuals who had not been considered gifted when in school—in fact, just the opposite, and had been placed in programs for slow learners. Others had been overlooked because they were blind, deaf, or had cerebral palsy. Clearly, these successful professionals were gifted, based on their performance in their fields (Maker, 1977, 1978; Whitmore & Maker, 1985). One of them had developed his own system of Braille notation for mathematics as a young boy (which continues to be used today by other mathematicians and is called the "Nemeth Code"), and another had been able to disguise his deafness until he was 8 years old, including reading and performing very well in school even though he had a 98 decibel hearing loss in both ears. In other words, he could barely hear a train coming until it was only a few feet from him. Another exceptional individual had convinced his father and principal to let him take physics during his last year in high school, after he had been in classes and programs for slow learners since second grade (due to his test scores and the fact that he couldn't read until he was 13), and had failed general math (Maker, 1977). In the physics class, he made the highest grade in the class! Of course, his teachers and parents were shocked, and this event caused quite a stir in his small town. He went on to complete college and become a very successful educational evaluator. Herbie, born with cerebral palsy, was my favorite. Herbie won a science fair as a child, typing his manuscript with his toes after his parents went to bed, on the typewriter they had bought for him to type his assignments (Whitmore & Maker, 1985). His winning of that science fair also caused some re-thinking on the part of his family and teachers. They didn't even know he had entered! He went on to become a very successful geologist.

My primary thoughts, going into the doctoral program were "What can I learn *from* and *about* these exceptional individuals that can help us design better instruments for identifying abilities and making judgments about children's capabilities?" "How can we avoid the damaging stereotypes that come from lenses clouded by our perspectives and limited by our narrow beliefs about human abilities and potential?" "What can we learn that will enable us to think in new ways about what we are seeing?"

During the doctoral program, my mentors cultivated and supported my interests, and I completed a series of interviews with exceptional people like Pete and Herbie (Maker, 1977, 1978), and decided that learning their perspectives about their own development and education was the first step to take in my quest. I received funding for a large study of successful scientists who either had a disability from birth or who had acquired such a condition before the age of 12. I interviewed those who had spent most of their school experiences as individuals with a disability. What a fascinating investigation this was for me (Maker, 1978). It changed my perceptions of individuals as well as my perspective on the field! It made me question our models and paradigms, and led me to pose a different way of defining giftedness, one based on an individual's willingness and ability to meet real challenges and resolve difficulties in their personal, academic, and professional environments in new and different, but highly effective ways (Maker, 1993). The existing definitions of giftedness based on percentages of those who achieved a certain score on a psychological measure seemed highly inadequate as a way to categorize a construct this complex and multidimensional. In the new definition, I wanted to capture a variety of perspectives about solving problems and meeting challenges, and to acknowledge the many ways one could judge the solutions others created.

At this point, I made an important move—from Virginia and my home area of the Southeast to New Mexico and Arizona in the Southwest. What I found was interesting, and also disturbing. Not only were students with disabilities perceived in a stereotypically negative light, but also those who did not speak English fluently and those who came from remote areas of the Indian reservations and Pueblos where life on a daily basis was very different from life in suburban and urban areas were perceived as deficient. These children were being placed in special education programs in increasingly high percentages, and many of them were there only because of their language and experiential differences (Baca & Almanza, 1991; Cummins, 1985, 1986; Figueroa & Garcia, 1994; Indian Nations At Risk Task Force, 1992; Ortiz & Yates, 1983). Much potential was being lost, and too many children were growing up thinking they faced a limited future. Now, I needed to expand my quest—to be serious about this new way of defining giftedness and to gain as much acceptance as possible for my ideas. However, first, I had to learn more, and to integrate the traditions that had shaped my world views. I had to study people from varied backgrounds, people of all ages, and people with a variety of ways of expressing their giftedness.

When Howard Gardner's book, *Frames of Mind: the Theory of Multiple Intelligences*, was published in 1983, this writing had a profound effect on me. It seemed that Gardner had synthesized a variety of perspectives in the development of his theory,

including psychology, education, neuroscience, and anthropology. His beliefs were consistent with mine, as evidenced by his definition of intelligence as

> a set of skills of problem solving enabling the individual to resolve genuine problems or difficulties that he or she encounters . . ., to create an effective product, and . . . the potential for finding or creating problems—thereby laying the groundwork for the acquisition of new knowledge. (pp. 60-61)

This seemed to be an appropriate framework within which I could define giftedness as "*the ability to solve the most complex problems in the most efficient, effective, or economical ways*." In addition, gifted or highly competent individuals "*are capable of solving simple problems in the most efficient, effective, or economical ways*" (Maker, 1993, p. 70). Later, as my colleagues and I were conducting the first studies of Navajo children's spatial problem solving, we found ourselves often saying "that's simple, but *elegant*!" So, I decided to add *elegant* to the list of important ways challenges could be met or problems could be solved. I have considered adding ethical, and still think deeply about it. However, because of constant international and cross-cultural experiences with the many and diverse ways "ethical" is interpreted, I have not formally added it to the definition.

Gardner seemed not to be particularly concerned about giftedness, but I was intensely interested in it, and could see that this framework would help to increase the perspectives from which we viewed the abilities of children and adults. The theory of multiple intelligences had been carefully conceived, and the boundaries of the "intelligences" or abilities were more logical and clear than others, such as Calvin Taylor's Multiple Talent Approach, that had influenced the field. Gardner's theory also included cultural context as an important variable to consider in the development and expression of intelligence. Wishing to have more validation for Gardner's ideas than their logical presentation in the book, with a colleague and graduate students, I designed a series of studies of individuals with high competence in each of Gardner's original seven intelligences. We received funding from the Office of Bilingual Education and Minority Languages Affairs, which enabled us to conduct some studies that would not otherwise have been possible, and continued these studies well beyond the grant period. In these studies, which were multiple case studies with the same design (Maker, 1993), nominations were solicited from a professional critic (e.g., an editor), a professional (e.g., a writer), and a teacher (e.g., a teacher of writing) in the appropriate field (in this example, linguistic); and we selected a man, woman, boy, and girl of average and high competence from each of Gardner's intelligences. Each participant was presented with a series of problem solving situations ranging from structured to unstructured, requiring the individual to draw upon knowledge, use processes, and develop products outlined in the theory as characteristic of a particular area of intelligence. We observed and videotaped individuals as they solved problems, and interviewed them to find out as much as possible about their thinking, visualization, and other cognitive processes as they were working. We studied Mexican American, Navajo, Caucasian, Asian, and African American children and adults of many ages, from 12 to as old as 67. They were from all economic groups, and their primary languages varied based on their backgrounds and

experiences. Some were truly balanced bilingual speakers of Spanish and English or Navajo and English, and some were dominant in one or the other of the languages they spoke. Some were not fluent in any language, and some spoke one language for social occasions and a different language for academic and formal occasions. Some spoke "Black dialect" and proper English, and one was particularly fascinating to me. He had grown up in inner city Denver, speaking Black dialect, and had moved to England during his military career. He switched easily and fluently from dialect to dialect, seemingly a different person based on the way he spoke.

In a sense, this design was a way of combining methods normally used in the different fields of psychology and anthropology—administering "psychological tasks" to a variety of individuals, but observing and interviewing the participants—to gain a broader perspective on their abilities and the interaction of their cognitive abilities with other important traits and experiences. In these studies, we found support for the theory of multiple intelligences, in that the people we observed exhibited the processes or "core competencies," used the knowledge, and developed the products Gardner had described as the essential elements of each area of intelligence. Interestingly, we also found that certain problem solving processes or behaviors were more general, and could be seen as people solved problems in all the ability areas observed. People also "personalized" their problem solving by drawing upon unique combinations of past experiences, varied patterns of abilities, and characteristic ways of thinking that reflected their language backgrounds.

These results led to a need to add to my emerging framework the theoretical perspective of Robert Sternberg in his Theory of Triarchic Mind and Successful Intelligence. Sternberg, unlike Gardner, argues for the existence of certain cognitive and conative traits that are more general than the "intelligences" or specific areas in which abilities are manifested. An individual's ability to think about her own thinking, identify his processes, and draw upon unique combinations of traits definitely was important in the process of meeting challenges and fashioning products important either to the culture or to the individual. I remember clearly how a 7-year-old girl who was selected because of her bodily-kinesthetic ability described her learning needs. She said she had to "move to learn" and that if someone made her stop moving, she stopped learning. To learn about someone, she had to "be" that person, and to learn about something, she had to "be" it; so she entertained us beautifully with her wonderful ways of "being" other people or things!

Another woman, a native speaker of Chinese, was selected for her logical-mathematical ability. She participated in the series of intensive case studies my students conducted after the funding period. In these studies, we presented each individual with the series of problems developed for all the intelligences, observed and videotaped them, and interviewed them about their processes and perceptions. These studies seemed necessary so we could begin to have an understanding of the interactions and connections among the various intelligences, which was not possible when participants were selected for a particular ability and only observed as they worked in their domain of talent. The Chinese mathematician demonstrated her logical-mathematical ability very clearly in the

task we had designed to measure it, but she also demonstrated this logical ability in other areas as well. The most dramatic example of how her math skills emerged through another area was during the musical problem solving. The structured task we had designed consisted of having the individual listen to the playing of a familiar song such as "Twinkle, Twinkle, Little Star" and a song we knew was unfamiliar to them, and asking them to play the songs on a xylophone immediately after hearing sections of them—so we could watch how they decided which note to play, see if and how they used trial and error strategies, and gain other useful information about how they compared tones or picked out the keys to play melodies. This gifted mathematician talked out loud as she picked out the tones, all the time telling how this was a new thing for her to do. Her self-talk and her later responses to our metacognitive interview questions were consistent. As she listened to the notes, she had attempted to "multiply, add, subtract, or divide" the tones in her mind so she could decide which note to play. She would add a tone to go up a note and subtract a tone to go down the scale, and would think carefully about whether a particular tone was "halfway" between two other tones!

Clearly, both these individuals, the 7-year-old dancer and the young adult mathematician, were very good at using metacognition, an important aspect of Stenberg's theory. They could think about and describe their own thinking, and they could survey their repertoire of abilities, skills, and experiences to select and apply those that were most relevant and had the most potential for success in the task at hand. In a way, they had a "main-frame" computer that decided which PC should be used for a particular task—the executive function in Sternberg's theory.

Another critical element in the framework I was constructing was the inclusion of both structured and unstructured problems. As I searched for definitions of problem solving, I found that in the study of intelligence, problems or tasks presented to subjects required the use of a particular strategy to reach a particular conclusion, or create a design that matched the one presented by the examiner or tester. This didn't seem to fit with what I had observed in the exceptional individuals who had such a profound impact on my thinking about giftedness. They had to find new ways to exist on a daily basis, and they were not successful because they reached the usual logical conclusions or met their challenges in the most accepted or conventional ways. However, from educational experiences in this field, I also knew that researchers in creativity had defined problem solving in a very different way—as the ability and willingness to create many solutions, unique solutions, and products that were elaborate and different. Creativity scores on tests were lower if the person used a common strategy or made the same design as the examiner. In the definition of intelligence Gardner proposed and the definition of giftedness I developed, we included both types of problem solving as important and relevant to decisions about abilities.

Inclusion of a wide range of structure in the challenges and tasks enabled us to learn much, much more about the abilities of individuals and the ways they used their experiences and knowledge. We also learned much more about what piqued their interest and kept them involved in and challenged by our tasks. Perhaps the most important general observation made across all ages of individuals, all observers, and all areas of

intelligence was that *in their areas of giftedness and talent, people preferred the open-ended tasks*. They became visibly more involved and interested as the activities permitted more individual variation and required more decision-making on their part. Interestingly, however, they also preferred the more structured activities in areas in which they were not gifted or perceived themselves as not as strong; and they visibly became more hesitant and sometimes more anxious as the tasks became more open-ended. In interviews, they confirmed our observations, and talked about their excitement to know we were interested in their unique ways of responding. Many of them also even manipulated the structured tasks in their areas of strength, doing them in the ways they found interesting rather than following the instructions!

I also believed that the inclusion of open-ended problems that were challenging and interesting to individuals gifted in a particular area also would enable us to learn more about those who came from environments and perspectives different from our own. For example, when an examiner presents a problem with a "correct" answer, such as "What is the square root of 48?" all he knows is whether the examinee knows the answer. He doesn't even know if the examinee knows how to calculate square roots! However, when that same examiner asks the test-taker to write as many ways to get the number "8" as possible, and gives time for thinking and problem solving, he can find out much more about what the person knows and can do. Similarly, when we asked participants to provide synonyms or definitions for words, we only found out that they knew or didn't know the words we had on our lists, but when we asked them to "write about anything you want to write about, and in any style," we found out what words they did know, how they constructed sentences, how they chose words for interest and other effects, how well they communicated, and many other important linguistic traits. In the assessment of abilities of children from different linguistic, cultural, and economic backgrounds, inclusion of this kind of problem solving enables an examiner to find out what knowledge the child does possess rather than finding out only what knowledge the child does not possess, and can judge competence more accurately. The knowledge any of us possesses is determined first by what we have been *exposed* to—what we have had the *opportunity* to learn—not only by our ability to learn it. Children from diverse backgrounds often have not had the opportunity to learn many of the concepts and information deemed important by the mainstream culture and included in tests or tasks designed by individuals immersed in mainstream ideas and experiences.

Developing the Assessment

I now found myself at another critical point in the development of my ideas. For several years, I had been studying how abilities were manifested and demonstrated in people of a variety of ages, had refined my definition of giftedness and confirmed my belief in it. I had learned a tremendous amount of information about how abilities were demonstrated across cultures and ages of people. Again, important questions emerged: What do teachers and psychologists really believe about the phenomenon of giftedness? Where did these beliefs originate? How did these beliefs form? What experiences with children and adults shaped these beliefs? How can we convince teachers and psychologists to re-consider and examine their beliefs? How can we convince them to

polish the lenses they use to see children, so they are not clouded with stereotyped beliefs about children from different cultures, language backgrounds, and impoverished economic conditions? How can we convince them to widen their lenses so they can see more—consider a wider array of talents and abilities or consider more varied traits of an individual as important? How can we help teachers and counselors design learning experiences that will provide challenges to students with varied abilities and patterns of abilities? How can we match programs and curricula to children rather than creating a program or a curriculum and finding the children who fit into what we made?

At this point, I was ready to tackle the practical problems of identifying and serving gifted students from culturally, linguistically, and economically diverse backgrounds—children who were disturbingly rare in most programs for gifted students. With the help of many colleagues and funding from both the Javits Gifted and Talented Education Program and the Office of Bilingual Education and Minority Languages Affairs, the framework developed through observations and case studies of individuals of many ages, I designed interesting, engaging tasks that would approximate as much as possible the kinds of activities usually used in a really good program for gifted students. The materials needed to be highly interesting, readily available, concrete, and appropriate to the domains of ability being assessed.

To make the assessments practical, we had to be able to do them in a classroom setting with groups of students, not with individuals taken to a room by themselves. Perhaps more importantly, I had learned that the context was very important, and the classroom environment was a familiar place for the students I was interested in identifying. I paid careful attention to the barriers and facilitators in other assessments (see Table 1 and explanation following it), and designed the assessments to minimize the barriers and increase the facilitators. Attention to test construction and design principles, and use of test development methods consistent with the framework and the belief system underlying it were important to this work.

The framework I was using included (at that time) seven different domains or intelligences (Gardner, 1983). However, knowing that development of assessments for all areas would take many years, I decided to begin with the areas normally accepted in the literature as distinct areas of ability, and those needed or developed in schools: spatial, linguistic, and logical-mathematical. Since the assessments would be done in groups, we would have an opportunity to observe interpersonal interactions as well. Another factor considered was Gardner's (1992) idea of "first-order" and "second-order" knowledge. First-order knowledge is knowledge gained from experience with concrete objects and personal interactions, and is what all of us come to school possessing. Second-order knowledge is what we learn in school: social conventions, written linguistic symbol systems, mathematical symbol systems. The assessment needed to include both types of knowledge so that we could judge not only what children knew from experience, but how much they had learned in school. The first set of activities, then, consisted of tasks considered to be a hands-on measure of spatial ability, a measure of first-order knowledge in math (working Tangram puzzles), a measure of first-order knowledge in linguistic intelligence (oral storytelling), a measure of second-order

knowledge in math (a worksheet of problems), and a measure of second-order knowledge in linguistic intelligence (open-ended writing). The first three activities were designed to be done in the classroom with observers, and the last two were designed so the classroom teacher could administer them, but they could be scored by someone unfamiliar with the children.

Consistent with an anthropological method, we did not generate rubrics or criteria to use in evaluating children's performance at this point (Maker, 1997). We designed a form for observers to use as they watched children. It had columns with the names of the activities in each set, with rows for the names of students observed, and as much space as possible to write observations. Observers were given a short orientation to the activities, and told to watch how the students solved the problems presented. They were to write everything they could about what they saw. Each observer was assigned a group of 5 or 6 students, and they rotated groups after each activity. Observers came from a variety of experience backgrounds, including counselors, school supervisors, directors of programs for the gifted, classroom teachers, teachers of gifted students, and university students in elementary, special, and gifted education at the undergraduate, master's and doctoral levels. Some were knowledgeable about the theories and frameworks underlying the assessments, and others were not. Many different cultures were represented, including Navajo, Tohono O'Odham, Yaqui, Mexican American, African American, Caucasian, and Asian; and ages of observers varied from 23 to 67. Each activity was done by all students at the same time, and the teacher gave the directions for the activities, using classroom management techniques familiar to the students. Students included those from Northern (mostly Navajo) and Southern Arizona (Mexican American, Tohono O'Odham, and Yaqui), California (Mexican American and Asian), and North Carolina (African American).

After each observation, my colleagues and I met with the team of observers to determine which students were "superior problem solvers" in each activity. We asked each observer to identify the best problem solvers in the group, and then to tell what that student *did* or *said* that led to this decision. If an observer gave an interpretation of behavior such as "highly motivated," we asked him to tell what he saw or heard that led him to conclude that the student was "highly motivated." In other words, the focus was on observable behaviors, not on inferences about those behaviors. In addition, since we were focused on problem solving *abilities*, not *disabilities*, we did not record any negative or ineffective behaviors. We wrote the observable superior problem solving behaviors, and kept a running list from all schools, grades, observers, and activities. We also videotaped many observations, and analyzed these tapes to gain additional information about the behaviors of students. We also interviewed observers, teachers, and the children to gain information about their perceptions of the assessments, and made revisions as needed to improve student engagement and to increase the ability of the observers to make appropriate judgments about the students they were observing.

After we had observed and collected data on approximately 5,000 children of varied ethnicities and ages, we found we were getting only repetitions of the behaviors already on our lists, so we now had confidence that the lists of behaviors were

comprehensive. Using content analysis, I developed categories of behaviors, and lists of the behaviors to be included in each category. I then gave the category names and an uncategorized list of behaviors to two colleagues, and they classified the behaviors according to my system. We disagreed on the placement of only a few behaviors, so the system seemed valid and workable. To resolve the disagreements, we either re-wrote the description of a behavior so it was clearer or we wrote two behaviors to avoid confusion about which category was the best place for the behavior (Maker, 1997).

After we had an instrument that seemed to work well, we continued to evaluate, refine, and study its characteristics so we could recommend its use with confidence that it would work well as a method for identifying gifted students (Maker, 1996). We wrote clear instructions for teachers and observers, and continued to refine the forms used for observations to make the task of observers as easy as possible. This process is continuing to this day! However, the refinements we now make are small and rather insignificant compared to the revisions during the first 10 years.

This now brings you up-to-date on my thinking and problem solving concerning the assessment. The next section contains a brief description of the assessment, and the following section has results of research on the instrument.

The DISCOVER Assessment

Repeated assessments, revisions, feedback, and on-going data collection have resulted in a set of activities for each of four grade levels (K-2, 3-5, 6-8, 9-12), standardized procedures and directions, a behavior checklist to provide consistency in evaluations, and a "debriefing" process for increasing interrater reliability. Assessments are conducted in the familiar classroom environment with the teacher as the facilitator. Other classroom teachers; specialists in education of the gifted, bilingual education, or special education; preservice educators, counselors; community members; administrators; and other experts are observers. Students, in groups of 4 to 5 peers, are encouraged to interact and meet the challenges presented. Bilingual observers and teachers present instructions and interact with children in the dominant language(s) of the students.

At this point, the set of DISCOVER recognized problem solving activities includes spatial artistic, spatial analytical, oral linguistic, written linguistic, and interpersonal assessments. Our research has resulted in the identification of a set of problem solving behaviors closely matched to the core capacities Gardner (1983) identified for linguistic, spatial, logical-mathematical, interpersonal, and intrapersonal intelligences. Other behaviors resemble traits found in the creativity literature (e.g., fluency, flexibility, elaboration, and originality) and research on eminent individuals (e.g., task commitment) (c.f., Renzulli, 1978; Torrance, 1972, 1974; Zuckerman, 1977).

The DISCOVER assessment has two main purposes. One is to identify students who are gifted so they can be served appropriately. The second is to identify the strengths and abilities of all students in the class. This information can be used to design

curriculum and instruction tailored to large-group, small-group, and individual needs, thereby giving teachers practical help in designing a learner-centered classroom (Bransford et al., 2000) After a DISCOVER assessment is completed, administrators, teachers, parents (and the students themselves, especially at the high school level) receive information about the students' strengths (inter-individual and intra-individual) across the domains assessed, as well as very detailed reports of the problem solving behaviors observed during each activity. Problem solving behaviors are reported for each domain, core competencies within each domain, and for creativity and task commitment clusters. Teachers, parents, and students are assisted in planning ways to build on student strengths as well as to compensate for weaknesses.

Research on the DISCOVER Assessment

For those who may wish to get more information or decide whether to implement the assessment, I provide the following summaries of research on various aspects of the assessment: (a) an overview of the research, (b) a table listing important information about each study, and (c) a summary of the results in list form with a reference to the study. This summary is not intended as a substitute for a detailed review of the studies, and readers are encouraged to examine them in depth. In the appendix, I include an annotated bibliography of published articles and research. Since this monograph is intended for a variety of audiences, a brief explanation of the reasons for studying a particular aspect of the assessment is included. Obviously, experienced researchers do not need this explanation, but it may be helpful for novices and practitioners who wish to evaluate the assessment.

During the past 15 years, colleagues, graduate students, and I have conducted studies of various aspects of the DISCOVER Assessment: consistency and reliability; inclusion of students from diverse linguistic, cultural, and economic backgrounds; theoretical or construct validity; concurrent validity; and predictive validity. Some studies have been published, some are master's theses or doctoral dissertations, and a few are internal reports designed to help us refine the assessment or detect problems we need to resolve. In Table 3, key information about each study is presented.

Table 3

Research on the DISCOVER Assessment

Author(s)	**Date**	**Topic**	**Participants N and Ethnicity**	**Type of Publication**	**Instruments**	**Design**	**Statistical Analysis**
Bunannad & Maker	In Review	Theoretical/ Construct Validity and Concurrent Validity	23 Navajo boys and 26 Navajo girls in Grade 3	Manuscript in review	DISCOVER Math CTBS ITBS	Descriptive Comparative	Correlation
Griffiths	1996	Consistency and Reliability	91 Native American (Yaqui and Tohono O'Odham) and Mexican American students ages 5 to 11	Internal Report for DISCOVER Manuscript in Review	DISCOVER	Descriptive	Percentage and Cohen's Kappa Correlation
Griffiths	1997	Concurrent Validity	33 Mexican American Children in Kindergarten	Dissertation	DISCOVER WISC-III WPPSI Raven	Comparative	Correlation Chi Square

Table 3 *(continued)*

Research on the DISCOVER Assessment

Author(s)	**Date**	**Topic**	**Participants N and Ethnicity**	**Type of Publication**	**Instruments**	**Design**	**Statistical Analysis**
Hipskind & Rogers	1999	Diversity	Ethnic Percentages based on 4,188 Caucasian, Mexican American, Native American (Yaqui and Tohono O'Odham), Asian American, & African American students in programs for gifted students Grades 1 to 12; achievement scores based on 1,143 students in self-contained classes for gifted students, including 381 ELL students in Grades 1 to 6	Conference Presentation	DISCOVER Raven Referral Checklists	Descriptive	Percentage
Kassymov	2000	Consistency and Reliability	5 DISCOVER Observers, 7-10 Hispanic Students 11 District Team Observers, 5-10 Hmong, Hispanic, Caucasian, and African American Students	Internal Report for DISCOVER	DISCOVER	Descriptive	Percentage

Table 3 *(continued)*

Research on the DISCOVER Assessment

Author(s)	**Date**	**Topic**	**Participants N and Ethnicity**	**Type of Publication**	**Instruments**	**Design**	**Statistical Analysis**
Lori	1997	Theoretical and Construct Validity	100 Bahraini students, 50 girls and 50 boys, ages 9 to 11	Journal Article	DISCOVER	Descriptive Comparative	Correlation *t*-test
Maker	2000	Concurrent Validity	72 Students in Grade 2, 37 boys, 35 girls; 18 African American, 24 Hispanic, & 24 Caucasian	Internal Report for DISCOVER	DISCOVER OLSAT	Comparative	Correlation
Nielson	1994	Diversity	Parents of 150 students in self-contained classrooms for gifted students, 56 from those identified by DISCOVER (in targeted high minority low income schools), 94 identified by Individual IQ Tests in a large urban school district	Dissertation and Journal Article	DISCOVER WPPSI WISC-R	Descriptive	Chi Square and Percentage
Powers	2003	Diversity	1,250 Students, mostly Hispanic with 635 ELL Students in Year 1 1,250 Students, mostly Hispanic with 936 ELL Students in Year 2	Evaluation Report to School District and Funding Agency	DISCOVER Cognitive Abilities Test	Descriptive	Percentage

Table 3 *(continued)*

Research on the DISCOVER Assessment

Author(s)	**Date**	**Topic**	**Participants N and Ethnicity**	**Type of Publication**	**Instruments**	**Design**	**Statistical Analysis**
Sak & Maker	2003a	Theoretical/Construct Validity	857 Hispanic, Native American (mostly Navajo but including Yaqui and Tohono O'Odham), African American, and Caucasian students in Grades 1 through 6	Conference Report Manuscript in review	DISCOVER Math	Descriptive	Correlation Coefficients of Determination
Sak & Maker	2003b	Predictive Validity	Study 1, 84 Mexican American, Native American (Yaqui and Tohono O'Odham), & Caucasian Students in Grade 6 Study 2, 83 students from the same ethnic backgrounds as Study 1, in Grade 4	Conference Report, Manuscripts in review and in preparation	DISCOVER Stanford 9 AIMS Grades in English, Math, and Science	Comparative	MANOVA Simultaneous Regression Analysis
Sarouphim	1997	Theoretical/Construct Validity	255 Mexican American, Native American (mostly Navajo), and Caucasian students in Grades 4 and 5	Dissertation	DISCOVER	Descriptive Comparative	MANOVA Chi Square Correlation

Table 3 *(continued)*

Research on the DISCOVER Assessment

Author(s)	**Date**	**Topic**	**Participants N and Ethnicity**	**Type of Publication**	**Instruments**	**Design**	**Statistical Analysis**
Sarouphim	1999	Concurrent Validity	2 Mexican American Girls age 5 and 5 ½	Journal Article	DISCOVER	Descriptive	None
Sarouphim	2000	Theoretical/Construct Validity	257 Mexican American, Native American (mostly Navajo), and Caucasian students in Grades K, 2, 4 and 5	Journal Article	DISCOVER	Descriptive Comparative	Correlation
Sarouphim	2001	Concurrent Validity	257 Mexican American, Native American (mostly Navajo), and Caucasian students in Grades K, 2, 4 and 5	Journal Article	DISCOVER and Raven	Descriptive Comparative	MANOVA Chi Square Correlation
Sarouphim	2002	Theoretical/Construct Validity	303 Mexican American, Native American, and Caucasian students in Grade 9	Journal Article	DISCOVER and Raven	Descriptive Comparative	MANOVA Chi Square Correlation
Sarouphim	2004	Theoretical/Construct Validity	395 Mexican American, Native American, and Caucasian students in Grades 6, 7, & 8	Journal Article	DISCOVER	Descriptive Comparative	MANOVA Chi Square Correlation

Table 3 *(continued)*

Research on the DISCOVER Assessment

Author(s)	**Date**	**Topic**	**Participants N and Ethnicity**	**Type of Publication**	**Instruments**	**Design**	**Statistical Analysis**
Shonebaum	1997	Diversity	10 students who were deaf	Thesis	DISCOVER WISC-III	Descriptive	None
Stevens	200	Concurrent Validity	55 Caucasian students in Grades K-4, 6, & 7 in a private school for gifted students	Thesis	DISCOVER WISC-R WPPSI TCT-DP SAT-9 SPQ	Descriptive Comparative	Correlation *t*-test Mann-Whitney U

Consistency and Reliability

Studies of consistency and reliability are important for any assessment because they give information about whether the same or comparable results could be obtained under different conditions or at a different time. Since decisions about student competencies are based on the judgments of observers, the most frequently-asked question regarding the DISCOVER Assessment is "Do different observers make the same decisions?" When we began conducting assessments, we realized that certain procedures were necessary to increase the probability that observers would make consistent decisions, so the following components were included: (a) a checklist of observable behaviors to guide the decision-making, (b) a "debriefing" session in which all observers in a classroom discuss the performance of all students and generate ratings together, (c) documentation (photographs of constructions, detailed notes and drawings, audio-recordings of stories) during the assessment so that discussions of student performance are as objective as possible, and (d) extensive education and practice for observers. Studies have been conducted to determine the extent to which these procedures result in inter-observer agreement. Results of these studies follow.

- Expert observers (those who have completed 30 or more assessments) agree with each other from 83 to 100% of the time, with an average of 97%. Experienced observers (those who have done 20 to 30 assessments) agree with expert observers from 66 to 100% of the time, with an average of 91%. Novice observers (those who are just beginning, or have completed less than 10 assessments) agree with expert observers from 20 to 100% of the time, with an average of 76% (Griffiths, 1996).

- Across all categories of experience levels, observers agree on the highest rating, definitely, 95% of the time. In other words, if a child is gifted in an activity, observers can recognize the child's outstanding performance regardless of their level of expertise (Griffiths, 1996).

- Across all categories of observers, the highest agreement is on ratings for the spatial analytical activity, perhaps because cut-off scores for ratings are assigned as a group rather than individually and performance on this activity is easier for observers to rate (Griffiths, 1996).

- The debriefing procedure is an important way to increase inter-observer reliability (Griffiths, 1996; Kassymov, 2000).

- School district level team members agree with each other, and with research team members more frequently than research team members agree with each other (Kassymov, 2000).

In a pilot study, Griffiths found that experience was a factor in the level of agreement of observers, so in the final study, this variable was examined. As predicted, she found that level of experience was important in ratings across lower levels of ability,

but that for the top ratings resulting in placement in a program for gifted students, observers agreed a high percentage of the time (95%) regardless of their level of experience. Another important result of her study was to confirm the importance of the debriefing session. In the single case of 83% agreement between expert observers, one of the observers was unable to participate in the debriefing session. Other agreement between experts was 100%. Kassymov included observer ratings before (not a part of the usual procedure) and after the debriefing (a usual procedure) to determine the influence of this discussion on observer agreement, and found it to be an important part of agreement between observers. Kassymov's study also was interesting because he found that the research team, consisting of several members with different perspectives on giftedness, disagreed more frequently with each other than school district team members disagreed with each other. However, district team members and researchers agreed with each other frequently. Kassymov examined data only from ratings of superior performance, so the number of participants was smaller than the number in Griffiths' study.

Diversity: Culture, Language, Gender, and Disability Factors

Because DISCOVER was created to help educators achieve more equity in the identification process, an important characteristic to study is the extent to which use of the assessment achieves these goals. In addition, we are concerned about equity for girls and boys and students with disabilities. An important assumption underlying the assessment is that giftedness is equally distributed across all cultural, linguistic, and economic groups, sexes, and students with disabilities. Therefore, we expect that the percentages of students identified as gifted from a certain population will be parallel to the percentages of students with particular characteristics in the population being assessed. Results of these studies follow.

- When kindergarten children are identified as gifted by DISCOVER, they have characteristics (ethnicity, ancestral origin, preferred language, second language, religious preference, mobility, family income, family home, parents' occupation, parents' educational attainment, and degrees earned) similar to the school and community population from which they come (Nielson, 1994).

- A comparison of DISCOVER-identified gifted students and traditionally-identified gifted students (using an individually-administered IQ test) showed that DISCOVER-identified students' families were similar to families of other students in their communities while traditionally-identified students' families were similar to families in Terman's longitudinal studies. For example, 50.5% of the DISCOVER-identified group was Hispanic and 78.5% of the traditionally-identified group was Caucasian (p=.0000); 21.8% of the DISCOVER-identified group and only 3.6% of the traditionally-identified group preferred to speak Spanish (p=.0000). Economically, only 31.4% of the DISCOVER-identified gifted students were in the top two quartiles of income while 56.1% of the

traditionally-identified students were at this level (p=.0012), and 43.6% of the DISCOVER-identified students and 74.6% of the traditionally-identified students lived in homes above the median in value for the community (p=.0019). In educational attainment, 8% of the DISCOVER-identified and 58% of the traditionally-identified students' parents had advanced degrees (p=.0000) (Nielson, 1994).

- No statistically significant differences have been found in the percentages of students from different cultural groups (Mexican American, Native American, and Caucasian) identified as gifted by DISCOVER across two studies. The percentages of identified participants were mostly in proportion to their ethnic distribution in the sample (Sarouphim, 2002, 2004).

- In a large urban school district in the Southwest, one school was selected to pilot the use of the DISCOVER assessment. Students had been assessed in previous years using traditional methods such as the Cognitive Abilities test, and only one English Language Learner (ELL) was identified as gifted out of a total ELL student population of 635 (.16%). The total school population was 1,250. The following year, DISCOVER was used as the identification instrument, and 50 (5.3%) of the 936 ELL students at the school were identified as gifted (Powers, 2003).

- In another large urban school district in the Southwest, procedures such as the Raven Progressive Matrices, a modified version of Frasier's key components of gifted students, peer referral, active recruitment, and assessment of all kindergarten students at selected high-minority schools have been used for several years to increase the participation of Mexican American, American Indian, and African American students in the program for gifted students. Use of DISCOVER, the Raven, and other active referral and recruitment procedures has resulted in a more equitable ethnic balance in this school district than in the majority of school districts in the State. For example, in the school year 2001-2002, White non-Hispanic students made up 41.3% of the total district enrollment and 47.7% of the enrollment in the program for gifted students, while Hispanic students made up 45.5% of the district's total student population and 38.6% of the students served in programs for the gifted. African American students, who constituted 6.7% of the students in the district, made up 6 % of the identified gifted students. American Indian students, constituting 4.0% of the total school population, made up 3.3% of the students served in the special programs for gifted students. Asian students, 2.5% of the school population, made up 5% of the students in programs for the gifted (Hipskind & Rogers, 1999).

- No statistically significant differences have been found in the percentages of boys and girls identified as gifted on the basis of DISCOVER

assessments across seven studies (Buhannad & Maker, 2002; Maker, Rogers et al., 1996; Sarouphim, 1997, 2001, 2002, 2004; Stevens, 2000).

- DISCOVER can be used effectively to identify strengths and giftedness in deaf students. The only modification needed is to video record the oral linguistic portion instead of audio recording it (Shonebaum, 1997).

- The behavior on the checklist that was most frequently observed in students, regardless of the rating they received was "follows through to completion," indicating that the activities are engaging to students of all age and ability levels (Sarouphim, 1997).

- In a private school for the gifted, the DISCOVER Assessment was found to be engaging for most students, regardless of teacher perceptions of usual classroom engagement (Stevens, 2000).

The first study showed that the assessment did what it was intended to do, and that a group of students previously overlooked was being identified (Nielson 1994). Nielson concluded that the profile of DISCOVER identified students was consistent with the profile of the families and children in the community, while the profile of students identified with an individual IQ test was consistent with the profile of the individuals and families in Terman's longitudinal studies. Later reports from the school district where these students were identified showed that they were successful in the programs for gifted students in which they were placed (Hipskind & Rogers, 1999). These school district reports are summarized in Sak and Maker (2003). In a different school district, which received federal funding for a bilingual program including the implementation of the DISCOVER Assessment, Powers (2003) found that its use increased the number and percentage of ELL students (Arizona's term for students whose home language is not English) identified as gifted. Across several studies, girls and boys are identified with equal frequency. Patterns of abilities in boys and girls were somewhat different, but the overall percentages of both sexes identified were the same. Students who are deaf can be identified using DISCOVER with minimal modification of testing conditions, although no studies have been completed with students who are visually impaired or blind. I suspect that several modifications will be needed to serve blind children adequately.

An important result of Sarouphim's (1997) and Stevens' (2000) studies is that the assessment is engaging to students of varying ages, ability levels, and those in varied settings. The students in Sarouphim's study were in Grades K through 6, of varied ability levels, and mostly Navajo and Mexican American. The students in Stevens' study were in Grades K through 8, identified as gifted, mainly Caucasian, and attended a special private school for gifted students.

Theoretical or Construct Validity

Studies of theoretical or construct validity are important because they help to understand whether the assessment fits the theory used to create the test. Construct

validity studies also contribute to an understanding of theories because theory development and testing need to follow an interactive or spiraling process. DISCOVER is based on three theories (explained in various sections of this monograph) with an important common element: abilities vary across domains or areas. One would not expect, for instance, that student performance in all ability areas would have a high correlation with each other. If abilities are separate, the correlations will be low; and if the abilities are separate, but related, the correlations still will be low, but might be statistically significant in a study with a large number of participants. Remember that a perfect positive correlation is 1.00 and a perfect negative correlation is -1.00, and that no relationship at all is .00.

When DISCOVER was first developed, we believed that the two spatial activities (spatial artistic and spatial analytical) would be highly related, and we also believed that the spatial analytical and mathematical activities measured similar abilities. The spatial analytical activity involved the use of concrete materials, while the mathematical activity involved the use of mathematical symbols and numbers. Similarly, we believed that the written and oral linguistic activities were both measures of linguistic abilities—and thus performance on the two activities would be similar. However, we believed that the lowest relationships would be between the linguistic and spatial activities. Repeated observations of students have convinced me and other expert observers that spatial abilities are quite varied, and that we are measuring different aspects of spatial ability in the two activities, and that spatial analytical ability is definitely different from mathematical ability. We also can see that the two linguistic activities are more closely related than other activities, but still measure different aspects of linguistic ability; and these observations have been confirmed by the results of Sarouphim's studies summarized in the following section.

The DISCOVER Assessment also is based on the belief that creativity and intelligence are not different constructs, but are different aspects of problem solving. Previous research showing differences in creativity and intelligence has resulted from the use of problems with a different structure to measure the two constructs. For example, items (tasks, questions, problems) used to measure intelligence have one right answer, an acceptable method of solution, and a well-defined problem, while items (tasks, questions, problems) used to measure creativity have many acceptable answers and many methods that can be used to reach a solution. Most items on both creativity and intelligence tests have fairly well-defined problems, but the problems on creativity tests usually are a bit more ambiguous or open to different interpretations. My underlying assumption is that problem solving is a general capacity that influences the expression of abilities in various domains or areas. The influence of this assumption is that I expect to see relationships among the DISCOVER activities designed to measure different areas of ability, and that performance on similar types of problems (the assessment includes problem Types I through V) will be similar. Types I and II require mostly what is often called convergent thinking, or knowing the correct solutions and methods, while Type III begins to require more of what is usually called divergent thinking or creativity, and Types IV, V, and VI require and develop the most creative and productive thinking. Performance on Type I

problems will, for instance, be more similar to performance on Type II problems than on Type V problems. Results of studies of theoretical or construct validity follow.

- Across three studies, including students in Grades K, 2, 4, 5, 6-8, and 9-12, low correlations have been found among observer ratings on the activities. Between spatial artistic and spatial analytical, correlations range from .02 to .23; between spatial artistic and math, from .09 to .26; between spatial artistic and oral linguistic, .07 to .14; between spatial artistic and written linguistic, .01 to .28; between spatial analytical and math, from .00 to .52; between spatial analytical and oral linguistic, from .08 to .29; between spatial analytical and written linguistic, from .08 to .29; between math and oral linguistic, .01 to .39; between math and written linguistic, from .05 to .21; and between oral and written linguistic, .29 to .56. At the high school level no logical-mathematical activity exists, but a separate activity is included to assess interpersonal ability. Observer ratings have a relatively low, similar correlation: between spatial artistic and interpersonal, .23; between spatial analytical and interpersonal, .28; between oral linguistic and interpersonal, .29; and between written linguistic and interpersonal, .23. Some of the correlations were statistically significant, and others were not. The most consistently high correlations were between spatial analytical and math and between oral linguistic and written linguistic. The ratings were relatively independent, showing that the activities measured different abilities. Even the written and oral linguistic activities tapped different aspects of linguistic ability. The overall pattern shows that the assessment fits the theoretical framework on which it is based [See the correlation matrix in Appendix A (Table 5) showing results across three studies of students at different grade levels.] (Sarouphim, 2000, 2002, 2004).

- Oral linguistic abilities in Bahraini third and fourth grade children were related to their interpersonal and intrapersonal abilities, and third grade children were better storytellers than fourth grade children (Lori, 1998).

- In math, accuracy scores (derived from the total number of correct problems written and solved) and strategy scores (derived from the thinking and problem solving strategies used in creating and solving problems) were correlated with total math scores at high levels (r=.97, p<.05 for accuracy and .89, p<.05 for strategy). Accuracy and strategy scores also were related (r=.78, p<.05) to each other, showing that the math assessment has internal consistency (Buhannad & Maker, 2002).

- In math, performance of students on the closed problems was more closely related to their performance on other closed problems than to their performance on the open-ended problems; the closer they were on the continuum, the higher the correlation. Type I problems correlated .49 with Type II, .41 with Type III, and .39 with Type IV. Type II correlated .39

with Type III and .36 with Type IV, and Type III correlated .46 with Type IV. All were statistically significant at the .01 level. These results show the construct validity of the problem continuum (Sak & Maker, 2003a).

- In math, performance of students on all problem types was correlated at statistically significant levels, showing that similar abilities were being measured across different problem types. Determinations of correlation coefficients varied from .16 to .24, showing a 16 to 24% overlap between problem types, showing they measure different, but related aspects of mathematical ability (Sak & Maker, 2003a).

- In math, scores on tasks requiring mainly convergent thinking were related to scores on tasks requiring mainly divergent thinking (.49); with a combined measure of originality, flexibility, and elaboration (.51); and with fluency (.44). Scores on tasks requiring mainly divergent thinking were related to combined scores on originality, flexibility, and elaboration (.86) and scores on fluency (.97). Fluency and the combined measure of originality, flexibility, and elaboration were correlated at .72. All were statistically significant at the .01 level. These results show support for the belief that mathematical ability is a distinct ability, and also supports both Gardner's definition of an intelligence as including both the solving of problems with known solutions and the solving of problems without known solutions (Sak & Maker, 2003a).

The most important series of studies of the relationships among sub-parts of DISCOVER are those conducted by Ketty Sarouphim. She repeated the same study with the four different forms of the assessment: K-2, 3-5, 6-8, and 9-12, and these results are reported in three publications. The results were consistent across studies—written linguistic and oral linguistic activities have the highest relationship, but still seem to tap different aspects of linguistic ability; logical-mathematical and spatial analytical ratings were related, and most other correlations ranged from .00 to .25 except one correlation between oral linguistic and math at Grade 4 (.39).

The second important study of theoretical and construct validity was the Sak and Maker examination of the relationship among problem types in the logical-mathematical activity. As expected, relationships between types varied according to their proximity on the continuum. Type I was most closely related to Type II and least closely related to Type IV (We have no Type V problems in the math assessment.).

Concurrent Validity

In concurrent validity studies, new instruments are compared to existing instruments designed to measure similar abilities or constructs. In a study of concurrent validity, for instance, researchers usually administer the new test and a well-established test to the same participants and determine the correlations of the scores. High correlations indicate that both tests are measuring the same construct, while low

correlations indicate they are measuring something different. Usually, researchers like to see low correlations between a new test and measures of constructs thought to be different, and like to see moderate correlations between the new test and established measures of a similar construct. They also like to see that the correlations are not too high, because no one will need the new assessment if it measures exactly the same thing as another well-established test. However, if the new assessment were much less expensive to administer but gave the same results as the expensive version, high correlations would be desirable.

Designing studies of the concurrent validity of the DISCOVER Assessment presents a challenge. Most tests include either items with right answers and accepted methods or items with many answers and several methods, but DISCOVER includes both types of items. Thus, no tests or subtests are available for direct comparisons.

Here is an example of the difficulty of designing concurrent validity studies of the DISCOVER assessment. The verbal subtests of the Wechsler Intelligence Scales (e.g., Vocabulary, Information, Comprehension) would be expected to have higher correlations with the DISCOVER oral and written linguistic tasks while the performance subtests (e.g., Block Design, Object Assembly, Picture Arrangement) would be expected to correlate more highly with the spatial analytical and spatial artistic tasks in the DISCOVER Assessment. However, the verbal sub-scale of the Wechsler Scales also includes math tasks and memory tasks. In the DISCOVER Assessment, no memory tasks are included, and math tasks are separated from linguistic tasks. Thus, direct comparisons between sub-scales and subtests on the Wechsler tests and the activities in DISCOVER are difficult. Then, when we add the fact that all the Wechsler subtests require only convergent thinking and the DISCOVER Assessment includes both convergent and divergent thinking, expected correlations are not easy to describe. Nevertheless, studying the relationships between instruments is essential to understanding both tests—their advantages and disadvantages—and establishing the new assessment as a valid measure of human abilities.

DISCOVER has been compared to teacher ratings and ratings of a researcher who observed students participating in classroom activities. It also has been compared to the Raven Standard and Coloured Progressive Matrices, the Wechsler Preschool and Primary Scale of Intelligence (WPPSI), the Wechsler Intelligence Scale for Children—Revised (WISC-R), the Wechsler Intelligence Scale for Children III (WISC-III), the Otis-Lennon School Abilities Test (OLSAT), the Stanford 9, the Iowa Tests of Basic Skills (ITBS), the Comprehensive Tests of Basic Skills (CTBS), and the Test of Creative Thinking—Drawing Production (TCT-DP). Following are results of the studies of concurrent validity.

- DISCOVER observers, an independent observer, and a teacher agreed on the ratings of students in areas in which specific activities are included (e.g., spatial, logical-mathematical, linguistic), but did not agree on ratings in intelligence areas in which specific activities are not included (interpersonal, intrapersonal) (Sarouphim, 1999).

- DISCOVER assessment ratings for spatial analytical, spatial artistic, and math were correlated at a statistically significant level with scores of participants on the Raven Progressive Matrices. This study provided evidence for concurrent validity because these parts of the DISCOVER Assessment are intended to measure abilities similar to those measured by the Raven. Most of the correlations were low, (approximately .30) and ranged from .09 (with written linguistic for the total group) to .70 (with spatial artistic at the fifth grade level) showing that the two assessments are measuring non-verbal ability, but that they tap into different aspects of that ability. At the kindergarten level a statistically significant relationship was found (r=.33) between written linguistic ratings on DISCOVER and Raven scores. This relationship was expected since in the kindergarten form of the DISCOVER Assessment, children draw a picture that tells a story and teachers record the words students say about the picture. Separating drawing ability from linguistic ability is difficult for those rating the drawings. However, the low, but significant correlation between the Raven and ratings on the oral linguistic activity (r=.29) was unexpected (Sarouphim, 2001).

- Total scores on the DISCOVER math assessment were related to scores on standardized math assessments (r=.33, p<.05) (ITBS and CTBS). Accuracy scores (r=.32, p<.05) and strategy scores (r=.30, *ns*) also were related to scores on standardized math assessments in third grade Navajo students (Buhannad & Maker, 2002).

- Relationships between DISCOVER math assessment accuracy, strategy, and total scores and standardized math achievement scores were different in third grade Navajo boys and girls. Boys' accuracy (r=.47, p<.05) and strategy scores (r=.47, p<.05) correlated with their standardized math achievement scores at a higher level than did girls' accuracy (r=.20, ns) and strategy (r=.20, *ns*) scores. Total scores for boys also were more closely related to their standardized math scores (r=.478, p<.05) than were total scores for girls (r=.21, *ns*). Girls often have higher strategy scores than accuracy scores on the DISCOVER math assessment, while performance on standardized math assessments depends mainly on accuracy and the total number of items the student can get correct within the time limit, without giving credit for problem solving strategies. Therefore, these different relationships between DISCOVER scores and standardized math scores are understandable. Please note that students do not receive strategy scores for incorrect answers, so these scores are not separated from the effective use of appropriate strategies (Buhannad & Maker, 2002).

- In gifted students, higher relationships were found between math strategy scores and math achievement (r=.69, p<.05) than between math accuracy scores and math achievement (r=.45, *ns*). The pattern was reversed for

non-gifted students: accuracy scores were correlated more highly with math achievement (r=.38, p<.05) than were strategy scores (r=.20, *ns*) (Buhannad & Maker, 2002).

- In a private school for the gifted, scores on the Wechsler Scales (WISC-R and WPPSI) used to place students in the school correlated at a statistically significant level with ratings on some activities in the DISCOVER assessment: spatial artistic and full-scale IQ, .37 (significant at .01 level); spatial artistic and verbal IQ, .27 (significant at .05 level); spatial artistic and performance IQ, .36 (significant at .01 level); written linguistic and full-scale IQ, .34 (significant at .05 level); and written linguistic and verbal IQ, .38 (significant at .01 level). Although correlations were significant, they were relatively low, indicating that the assessments measure related, but different abilities (Stevens, 2000).

- In the private school for the gifted, DISCOVER assessment ratings on only one activity were correlated at a statistically significant level with scores on Stanford 9 reading or math. Written linguistic was related to performance in math (.33, significant at the .05 level) (Stevens, 2000).

- In the private school for the gifted, correlations between DISCOVER assessment ratings and scores on the TCT-DP ranged from -.07 (Spatial Artistic) to .245 (Math); none were statistically significant (Stevens, 2000).

- In a study of 34 Mexican American kindergarten students identified as gifted using DISCOVER, no significant relationships were found between DISCOVER and WISC III or WPPSI verbal or performance IQ or full-scale IQ. In this case, IQ scores ranged from 88 to 137 with a mean of 115 (Griffiths, 1997).

- DISCOVER Assessment ratings on the spatial analytical activity correlated with total IQ (r=.272, p<.05) measured by the Otis-Lennon School Abilities Test (OLSAT) in second-grade students (N=72). For male students (N=37) the relationship was stronger (r=.441, p<.05), but for female students (N=35), the only significant relationship was between DISCOVER math and non-verbal IQ (r=.454, p<.05). When scores were analyzed separately by ethnicity, no significant relationships were found for Hispanics (N=24), or African American (N=18) students. However, for Caucasian students (N=24), significant relationships were found between the spatial analytical assessment and total IQ (r=.477, p<.05), and between spatial artistic and non-verbal IQ (r=.719, p<.05) (Maker, 2000).

The largest and most significant of the concurrent validity studies was Sarouphim's (2001) comparison of DISCOVER ratings and scores on the Raven. Her sample consisted of 257 participants from six schools, and included kindergarteners, second, fourth, and fifth graders predominantly from Navajo and Mexican American

backgrounds. She found low and significant correlations between Raven scores and the DISCOVER non-verbal activities. She found low and significant correlations between Raven scores and the DISCOVER verbal activities only at the kindergarten level. Buhannad and Maker's study is interesting, as it shows that the DISCOVER math assessment measures abilities similar to those measured in math achievement, that gifted students' math problem solving skills are closely related to their performance on a math achievement test, and the relationships among scores are different for boys and girls. Since the study included only 49 Navajo students at one grade level, it needs to be replicated with other, larger groups. Stevens (2000) and Griffiths (1997) had restricted ranges of one or the other of the scores, and did not use any correction measures. If the range of scores is restricted, correlations tend to be lower than if a complete range of scores is included in the analysis. Stevens studied Caucasian students identified as gifted on the Wechsler Scales, Griffiths studied Mexican American Students identified as gifted on the DISCOVER Assessment; and both compared performance on the two measures. The comparison of the OLSAT and DISCOVER included a small number of participants from second grade in one school district, and should be replicated with a larger, more diverse group.

Predictive Validity

Predictive validity studies are particularly important for instruments designed to identify either abilities or disabilities, and thus are critical to the validation of instruments used to place students in programs for gifted students. Finding more gifted students from underrepresented populations is one piece of the puzzle, but is not enough to justify the use of a particular instrument over time. Studies showing that students who have been identified as gifted perform at a higher level than students not identified as gifted provide data essential for decision-making about the use of a particular instrument. Criteria used to determine "success" are particularly important, and can include grades, scores on achievement tests, evaluation of portfolios and other indicators of performance, and teacher ratings of student ability or performance. Often, combinations of criteria are used because a variety of factors can influence performance or ratings of performance. One of the problems to be solved in predictive validity studies, for example, is whether the student's placement in a special program contributed to the student's success rather than the student's giftedness. To conduct a study in which placement and identification are separated, a researcher needs to identify a group of gifted students using the new instrument, randomly place some of the students in a gifted program and the others in a regular classroom setting, and assess all the students after a long enough period of time for them to demonstrate differences in achievement or other indicators of performance. Studies in which these factors are separated are rare because many educators believe that identifying students as gifted, and not placing them in a special program, is unethical. In many cases, the school district administrators will not allow such studies to be conducted.

Two studies of the predictive validity of DISCOVER have been conducted. In both cases, students were identified in kindergarten and multiple measures of performance were collected several years later. In one study, students' scores at Grade 4 were analyzed, and in the second study, their scores at Grade 6 were analyzed. Grades in

math, language arts, and science; Stanford 9 scores in math and reading; and scores on Arizona's Instrument to Measure Standards (AIMS) were collected and compared to DISCOVER Assessment ratings in both studies. One study is in review and the other is in preparation. Both were presented at a conference, so the summary below is taken from results presented at the conference. In addition, I have included results of an analysis of gifted students' performance in a large urban school district in which DISCOVER is used for placement.

- As the enrollment of culturally and linguistically diverse students in the program for gifted students in a large urban school district (where DISCOVER, the Raven, and active referral and recruitment strategies are used to identify gifted students from underrepresented groups) increased—from 38% in 1995-96 to 52.2% in 2001-02—student achievement in the program also increased. In the self-contained program (Grades 2-8) reading scores increased from 8.8 stanine in 1996-1997 to 9.1 stanine in 2000-2001, math from 8.6 to 9.3, and language from 8.3 to 8.9. Clearly, students with high learning potential were selected by the methods employed, and the students performed well in the program (Hipskind & Rogers, 1999).

- Kindergarten children (mostly Mexican American and American Indian) identified as gifted in linguistic ability performed higher than their sixth grade peers who were not identified as linguistically gifted in Stanford 9 reading and math, AIMS math, and in school achievement (grades) in math and science classes (F[14, 108] f=1.83, p=.042; Wilkes' Lambda=.65; partial eta squared [d]f=.19). The DISCOVER assessment identified linguistic abilities at the kindergarten level that influenced achievement in reading, math, and science 6 years later, even though most of the students had not been in a special program for gifted students (Sak & Maker, 2003b).

- Kindergarten children (mostly Mexican American and American Indian) identified as gifted in mathematical ability performed higher than their sixth grade peers who were not identified as mathematically gifted in Stanford 9 math (F=6.14, p<.01; partial eta squared [d]=.17), AIMS math (F=6.14, p<.01; partial eta squared [d]=.12) and in school achievement (grades) in math (F=4.50, p<.01; partial eta squared [d]=.13) and science (F=5.95, p<.01; partial eta squared [d]=.16). The DISCOVER assessment identified mathematical abilities at the kindergarten level that influenced achievement in math and science 6 years later, even though most of the students had not been in a program for the gifted (Sak & Maker, 2003b).

- Kindergarten children (mostly Mexican American and American Indian) identified as gifted in spatial analytical ability performed higher than their sixth grade peers who were not identified as gifted in spatial analytical ability in Stanford 9 math (F=7.02, p<.01; partial eta squared [d]=.19)

AIMS math (F=7.29, p<.01; partial eta squared [d]=.19) and grades in science (F=4.05, p<.01; partial eta squared [d]=.12). The DISCOVER assessment identified spatial analytical abilities at the kindergarten level that influenced achievement in math and science 6 years later, even though most of the students had not been in a gifted program (Sak & Maker, 2003b).

- Kindergarten children (mostly Mexican American and American Indian) identified as gifted in spatial artistic ability performed higher than their sixth grade peers in Stanford 9 reading (F=3.40, p<.05; partial eta squared [d]=.10) Stanford 9 math (F=5.62, p<.01; partial eta squared [d]=.16) AIMS math (F=5.22, p<.01; partial eta squared [d]=.15) and academic achievement (grades) in English (F=5.98, p<.01; partial eta squared [d]=.17) math (F=4.74, p<.01; partial eta squared [d]=.13), and science classes (F=5.53, p<.01; partial eta squared [d]=.15). The DISCOVER assessment identified spatial artistic abilities at the kindergarten level that influenced achievement in reading, math, English, and science 6 years later, even though most of the students had not been in a program for gifted students (Sak & Maker, 2003b).

- Ratings on the DISCOVER linguistic assessment predicted Stanford 9 reading and AIMS reading scores, and ratings on the mathematical assessment predicted Stanford 9 math and AIMS math scores of Mexican American and American Indian students when they were in Grade 3. The model that included all the independent variables (linguistic, mathematical, spatial analytical, and spatial artistic ratings) explained 22% of the variance in Stanford 9 Reading, reaching statistical significance (p=.003). The variable "linguistic" was the only predictor that made a statistically significant *unique* contribution to explaining students' achievement in Stanford 9 Reading (beta coefficient=.35; p=.006). Also, the model predicted 25% of the variance in AIMS Reading, reaching statistical significance (p=.003). The model accounted for 20% of the variance in Stanford 9 Math. This result was statistically significant at the .007 level. In this equation, only "logical-mathematical" made a statistically significant contribution (beta coefficient=.29; p=.033). Furthermore, the model *as a whole* explained 20% of the variance in AIMS math (p=.009) (Sak & Maker, 2003b).

Current and Future Efforts

Results from research on the DISCOVER Assessment provide support for its use to identify students from culturally, linguistically, and economically diverse groups. More studies have been done with this "alternative" assessment than with most other such instruments in use in our schools. Clearly, however, more research is needed, especially predictive validity studies with different populations. More research is in progress, and will be submitted for review and publication as results are available. At this time, for

example, the University of Arizona research team is analyzing all our data on students' performance on the spatial analytical activities, including scores from over 4,000 students at various grade levels and from varied ethnicities (Muammar, Maker, & Kuang, 2004). In these studies, we will derive average scores and standard deviations for various groups. The information on averages and standard deviations will be provided to help assessment teams when they are assigning ratings during the debriefing process. We also will analyze the time taken to complete each puzzle to make certain the difficulty levels are appropriate and the pages are sequenced appropriately. An in-depth analysis of the oral storytelling using other methods for viewing children's stories will help us understand whether new items need to be added to the checklist (Mohamed & Maker, 2004). In another study, we are examining the development of math problem solving skills, and looking at the relationships between mathematical knowledge and divergent production from a developmental perspective (Sak & Maker, 2005).

In other countries, I am working with professors at various universities to develop versions of the assessment that will be appropriate and useful. In some cases, these versions involve use of the same format for assessment, but confirming the use of the superior problem solving behaviors already identified while observing carefully to identify additional behaviors from a different cultural group. In two other countries, we are adapting the format of the assessment, and writing curriculum-based activities to make the assessment more useful in a different context. This work will be described in the practical applications section, and the materials designed in one country (England) are included in Appendices D and E. I am open and receptive to cooperating to design and conduct research and other pilot programs in this country as well!

Developing the Curriculum and Teaching Strategies

Once we began to use the new instrument, we could see a mismatch between the identification and many traditional curricular approaches in use. One major mismatch was an overemphasis on linguistic abilities almost to the exclusion of spatial, non-verbal, and logical-mathematical abilities in programs for gifted students. Another mismatch was in the use of identification procedures and instruments emphasizing "one-right-answer" problem solving to place students in programs in which students were expected to generate many answers and solve real-life, "ill-structured" problems.

Using the framework developed over the years and equipped with the knowledge and experience I had gained from observing children as we conducted assessments, my colleagues and I again found methods from anthropology to be the most useful as we began to design curriculum and teaching strategies. Although we had proposed the kind of research and development methods required by the government funding agency, and had an experimental and comparison group of teachers, we quickly found that this design simply didn't work in schools situated in impoverished, and often remote, areas of the state. One problem was that the principals and other administrators who had selected the teachers for the "experimental" and "comparison" groups sometimes selected as experimental teachers the teachers they believed were most in need of change. Their reasoning was that we were going to offer great opportunities, and improvements in

"struggling" teachers could help their schools. As you might imagine, most of the teachers in this category had no desire to change! Uninterested teachers came to the workshops, and often graded papers throughout the activities. Not all administrators made these kinds of choices, and we certainly had some exceptional teachers in both groups. Another problem was that several teachers in the "comparison" group became interested in what was happening, and really wanted to come to the workshops. None of us—administrators, staff, me—was willing to deny these teachers the opportunity to attend staff development opportunities. Many times, we were in high-poverty and remote areas where teachers had few chances to learn new ways of teaching or to participate in interesting workshops. What evolved was a design in which many different kinds of staff development models were offered: regional workshops, school-wide workshops, classroom observations with recommendations for providing for specific students, demonstration teaching on topics requested by the teachers, and a week-long state-wide teacher institute. All teachers from the schools involved in the project, or from other schools nearby, could attend the workshops as long as space permitted. We focused more on helping the teachers in the experimental group, but were available for all teachers when time permitted.

In the workshops and staff development activities, the emphasis was on teaching the framework of the project—how to design problems and problem solving experiences using the problem continuum, multiple intelligences theory, and the principles for teaching gifted students (Maker, 1982; Maker & Nielson, 1996; Maker & Schiever, in press). Another aspect of the reality of conducting research is that investigators cannot assume that just because a teacher is in an experimental group and has learned certain strategies he or she will implement these strategies! Researchers must find out *if*, *how*, and *how frequently* teachers are teaching in ways compatible with the theory or framework being tested.

The second step in the research design process was to develop a format for observing all teachers. The form we created was similar to the forms initially used to observe children, but had slightly more structure. On the first page were large blocks of empty spaces in which an observer wrote a detailed description of what he or she saw the teacher and students doing. Along the sides of the form were codes for the seven (later, eight) intelligences, the five problem types (ranging from closed to open), and the content, process, and product modifications included in my books on curriculum development and teaching strategies for gifted learners (Maker, 1982; Maker & Nielson, 1996; Maker & Schiever, in press). A blank space after each code was used by the observer to check whether a particular intelligence, problem type, or modification was included in the activity described in detail in the written portion of the observation. On the second page were three large blank spaces. In the largest, the observer was required to draw a diagram of the classroom. The diagrams were supplemented by photographs of the classroom environment. A smaller space was designated for the observer to write notes about student products observed in the environment, and another space was designated for the observer to write the results of conversations with the teacher. On this page, codes were included that related to the problem types observed in materials on

walls and bulletin boards as well as codes related to the learning environment modifications included in my books.

All teachers in both the comparison and experimental groups were observed at least twice each year, and most observations lasted at least an hour and a half. Many teachers were observed more times, depending on their willingness to have us come into the classroom and work with them. All teachers also were interviewed about their beliefs about gifted students. Interviews consisted of open-ended probes based on the teachers' responses to questions they received before the interview. Questions included such probes as "Which students in your class do you think are gifted? Please choose two and tell us more about them." I notice that you describe (name of student) as (characteristic). Why do you think (name's) (characteristic) is an indicator of giftedness? The interviewer then focused on each student identified and elicited one specific activity in which the teacher felt the student exhibited her or his giftedness. Several open-ended, probing questions were asked about the causes and effects of the students' actions, the teacher's purpose in doing the activity, and the relationship of the activity to the teacher's overall goals.

From these interviews and observations, we derived a list of criteria that seemed to distinguish the teachers who were the most effective from those who were less effective implementers of the framework (Maker et al., 1996):

1. Integrates multiple intelligences through self-selected product formats, available/accessible tools, and choices based on interests and strengths.
2. Poses a variety of types of problems and, at times, encourages students to design their own problems, to access information and demonstrate understanding.
3. Collaborates with students to establish a learner-centered environment that includes student choice, flexible schedules and grouping, standards for behavior, sharing, openness, and acceptance.
4. Organizes content around broad-based, interdisciplinary themes.
5. Models a variety of processes and gives students opportunities to use the processes to access and transform information.
6. Encourages students to develop varied products that reflect the diverse strengths, interests, and preferences of students.

In the second year of funding for the project with targeted and comparison teachers, we conducted a pilot study using these criteria to distinguish a "high" and "medium" implementer of the DISCOVER Curriculum model (Maker et al., 1996). The differences between the two teachers did have an impact on their children's performance that year, and we found changes in children from pretest to posttest even though children only had 7 or 8 months between assessments. The results of this pilot and the larger study at the end of the project led us to propose a different research design for the next proposal. We also knew from experience that the total school "culture" had a tremendous impact on the teachers' willingness and ability to implement the kinds of changes needed within the new framework. In many of our schools, the support from administrators was

high, and in others, changes in principals, coordinators of gifted programs, and high staff turnover resulted in very little impetus for meeting the needs of the children who were identified as having high potential. Another surprising finding was that in the high implementer's class, students who were "on the borderline" between being considered gifted and being seen as having high, but not gifted, ability, changed so much during the year that they were considered gifted at the end of the year. This did not happen in the middle implementer's classroom. In addition, some of the students considered gifted at the beginning of the year did not perform at this level at the end of the year in the middle implementer's classroom. Based on this surprising result and our increasing concern with overall development of talents and abilities in "at-risk" children, we proposed a much different approach for the next project.

In the next project, we selected a few schools with high interest and administrators with a philosophy that fit within the DISCOVER framework; and we worked with all children, all teachers, and the community. We received funding from the Javits Gifted and Talented Education Program and from a school on the Navajo Nation. Again, we focused on schools in poverty areas and schools with high percentages of students from groups usually underrepresented in programs for the gifted. One school had 98% Hispanic students; one 99.5% Navajo students; and another, in a desegregation zone, had 50% African American and 50% Caucasian students. The fourth school had a mixed population, including mostly Mexican American (64%), with African American (15%), Yaqui Indian (3%), and Other (Asian American and mixed ethnicity) (3%).

A site coordinator from our team was assigned to each school. The site coordinator spent 1-2 weeks each month at her or his school, working with all professional and para-professional staff members and interested parents. At the beginning of the project, we assessed children's problem solving abilities using the DISCOVER assessment, and gave teachers information about the strengths of the students, both as individuals and as a group. The site coordinator and other curriculum specialists or teaching artists from our team provided staff development workshops and curriculum development assistance to all teachers, administrators, specialists, and teaching assistants at these four low-income schools in both rural and urban areas of the country. We demonstrated how to teach based on the project framework using State and National Standards and the content of the individual classrooms, recommended teaching materials, and supported the educators in whatever ways they requested. Each year, we observed all the teachers in their classrooms at least one time, completing the observation form developed in the previous project. We also interviewed all the teachers about their beliefs and classroom practices using the format designed in the previous project. Students were assessed with the usual end-of-year tests required by the states or local school districts, and we assessed their creativity at the end of each year. At the end of the project, two individuals familiar with the school (one was always the site coordinator for the school) reviewed all the materials available on a particular teacher (observation forms, interview results, student products) and rated him or her on the six criteria derived from the pilot studies as important in the implementation of the DISCOVER Curriculum Model (listed previously).

The two ratings on each criterion were combined to form one score for each rater. Then, we examined the scores for extreme discrepancies. If one rater had, for example, given an overall score of 1.5 while another had given 3.5 or higher, the raters were required to discuss their ratings and reach agreement on individual scores or definitions of the rating criteria. Finally, all scores were averaged, and a "level of implementation" score was assigned to each teacher. A teacher who implemented most of the DISCOVER Curriculum model principles most of the time was given a rating of "5" and called a "high implementer," a teacher who implemented some of the principles some of the time (ratings of 3 or so) was called a "middle implementer," and a teacher who seldom implemented any of the principles was given a rating of "1" and labeled a "low implementer." We then compared the creativity and achievement of students in the classes of high, middle, and low implementers. This design differs from the usual experimental and control design in that teachers were not arbitrarily assigned to the treatment groups, and we know (rather than assume) that differences existed between the classrooms on the criteria found to be important in implementing the theoretical framework of the project.

We are analyzing the results of the large study, but have completed smaller analyses. We compared high, low, and middle implementers at one school, and compared schools with a high percentage of high implementers with schools that had a low percentage of high implementers. We expected that students in schools with a high percentage of high implementers would make greater overall gains than the schools with a low percentage of high implementers—that is, if we could attribute gains to their use of the DISCOVER Curriculum Model.

This brings you up-to-date on how the curriculum and teaching strategies of the DISCOVER Model were developed. Next, I present a brief overview of the Curriculum Model. In the "Practical Applications" section, I give examples of how these principles were implemented. Since the research projects were completed, I have continued to work closely with schools, teachers, parents, and policy-makers to apply principles of education for gifted students to enhance the education of all students, helping them to reach national and international standards of excellence. This curriculum model represents my current synthesis of these ideas, experiences, and perspectives. Appendices F, G, and H contain three teaching units based on the DISCOVER Curriculum Model and principles for teaching gifted students.

The DISCOVER Curriculum Model

In the DISCOVER Projects, an educational framework has been developed in which "at-risk" students are viewed as being "at-promise" for success due to their problem solving strengths in diverse cognitive domains. When students' strengths are identified and teaching approaches developed so that strengths are used as vehicles for developing academic and real-life skills, students from all groups, including those considered to be "at-risk" experience greater success in school (Maker, 1992; Maker et al., 1996). They and their teachers and caregivers develop more positive and realistic beliefs

about their potential to succeed. When academic skills are taught within the context of real-world problem solving, these academic skills take on new meaning, and are perceived as relevant.

A consistent message of school reform efforts is that students in America's schools must learn to think and solve problems rather than memorize facts and mindlessly apply algorithms: (a) "Problem solving is an integral part of all mathematics learning." (National Council of Teachers of Mathematics [NCTM], 2000, p. 11); (b) "Inquiry into authentic questions generated from student experiences is the central strategy for teaching science." (National Academy of Sciences [NAS], 1996, p. 31); (c) "Our children will thus need to be prepared not just with a larger set of facts or a larger repertoire of specific skills but with the capacity to readily acquire new knowledge, to solve new problems, and to employ creativity and critical thinking in the design of new approaches to existing problems." (President's Committee of Advisors on Science and Technology Panel on Educational Technology [PCAST-PET], 1997, p. 10)

A second consistent message is that a "constructivist" (rather than a "reductionist") approach is the most effective way to achieve the new national standards, and that certain key elements characterize this approach: (a) actively building new knowledge from experience and prior knowledge; (b) acquisition of higher-order thinking and problem-solving skills; (c) basic skills learned in the course of undertaking higher-level, "real-world" tasks whose execution requires the integration of a number of skills; (d) information resources available to be accessed by the student at that point in time when they actually become useful in executing the task at hand; (e) fewer topics covered and explored in greater depth; and (f) students as active "architects" rather than passive recipients of knowledge (NAS, 1996; NCTM, 2000; PCAST-PET, 1997).

The national standards reports result from the thoughtful reflection of educators, educational researchers, cognitive scientists, leaders in business and industry, and public policy-makers in this country. They reflect a shared vision about what we need for the future. Yet in the majority of our schools, the acquisition of facts, using methods emphasizing drill and practice is the norm—a fact also recognized by the authors of the national standards reports. Embedded in these reports, and documented in numerous studies, is the significant impact of assessment on curriculum and pedagogical practices (NAS, 1996; NCTM, 2000; Pellegrino et al., 2001; PCAST-PET, 1997; Shavelson & Baxter, 1992; Smith, 1991; Wiggins, 1989). A statement from the report on technology sums up the problem expressed by many:

> Conventional, standardized multiple-choice tests offer the advantages of widespread availability, straightforward administration and scoring, and familiarity to and credibility with the public at large. Such tests, however, tend to place greater emphasis on the accumulation of isolated facts and basic skills, and less on the acquisition of higher-order thinking and problem-solving skills, than would be desirable for the measurement of those forms of educational attainment that are central to current reform efforts. (PCAST-PET, 1997, p. 4)

The DISCOVER Curriculum is based on a constructivist philosophy, and involves using the principles of a good program for gifted students to enhance learning and raise the standards for all students. Curricula and teaching strategies for gifted students are characterized by (a) integrated, interdisciplinary content; (b) higher-order thinking, appropriate pacing, self-directed learning, and complex problem solving processes; (c) development of unique products for real audiences; (d) student interaction, interaction with experts, and learning environments with physical and psychological flexibility, openness, and safety. The environment is rich in resources, and the teacher usually acts as a guide rather than a dispenser of knowledge as the students make choices based on interest and ability (Maker, 1981, 1982; Maker & King, 1996; Maker & Nielson, 1995, 1996). These principles advocated for gifted programs characterize successful bilingual education programs (Cummins, 1984; Nieto, 1996; Rameriz, J., 1991; Tharp, 1989), effective schools (Heckman, 1996; Weissbourd, 1996), and early childhood programs incorporating developmentally appropriate practices (Bredkamp & Rosegrant, 1995; Maker & King, 1996). In addition to these principles, the DISCOVER curriculum model includes two other elements to broaden its applicability to students with diverse backgrounds and personal traits, including types of abilities. These two important elements are (a) arts integration, especially visual arts, music, creative dance/movement, and theater arts; and (b) development of a wide range of problem solving abilities.

Research on the DISCOVER Curriculum Model

To provide resources for those who may wish to get more information or decide whether to implement the curriculum model, I provide a summary of the results of research on various aspects of the model. In the section of this monograph immediately before the description of the current version of the Curriculum Model, I explained in detail the overall research design. In Table 4, I list the studies completed and give information about methods used in each of them, and following this table, I provide a summary of results in list form so readers can decide which results are most interesting or important, and follow-up on these studies. The list is not intended as a substitute for a detailed review of the studies, and readers are encouraged to examine each study in depth. After each result, I provide a reference, and in the appendix, include an annotated bibliography of published articles and research.

- Second grade students in the bilingual classroom of a high implementer showed greater gains in spatial artistic, oral linguistic, and math problem solving abilities from pretest to posttest than did students in the middle implementer's bilingual classroom. These differences were statistically significant at .009 and .001 levels (Maker et al., 1996).

Table 4

Research on the DISCOVER Curriculum

Author	Date	Participants *N* Ethnicity	Type of Publication	Instruments	Design	Statistical Analysis
Maker, Rogers, Nielson, & Bauerle	1996	HLI: 23 Mexican American and 1 Caucasian student, ages 6-8 MLI: 22 Mexican American and 1 Caucasian student, ages 6-8 67% of students in both classes were Spanish dominant	Journal Article	DISCOVER	Students in HLI Classroom compared to Students in MLI Classroom	Chi Square *t*-Test
Maker & Taetle	In Review	56 Students in year 1 and 70 students in year 2. All were 4th grade students: 49% African American and 51% Caucasian, Asian, Somalian, and Hispanic	Manuscript in Review	DISCOVER KIRIS CATS	Students in HLI Classrooms were compared to students in MLI and LLI classrooms	ANOVA

Note: HLI: High Level Implementer of the DISCOVER Curriculum Principles
MLI: Middle Level Implementer of the DISCOVER Curriculum Principles
LLI: Low Level Implementer of the DISCOVER Curriculum Principles
KIRIS: Kentucky Instructional Results Information System
CATS: Commonwealth Accountability Testing System

- In the classroom of a high implementer of the DISCOVER curriculum principles, increases in math scores were related to language preference: children who preferred to write in Spanish showed a significant increase (at the .005 level), and those who preferred to write in English showed a significant increase (at the .05 level). In the middle implementer's classroom, no significant increases were seen, but a high positive relationship was found between math scores and language for those who preferred to write in English, but not for those who preferred to write in Spanish (.83, significant at the .05 level) (Maker et al., 1996).

- In the bilingual classroom of a high implementer of the DISCOVER curriculum, three students were identified as gifted at the beginning of the year, and in the middle implementer's classroom five were identified. At the end of the year, the same three students and seven additional students were rated at the gifted level in the high implementer's classroom, while in the middle implementer's bilingual classroom, three of the six identified at the beginning of the year still were rated at that level, but three were not. Three additional children were identified. These results showed consistent nurturing of abilities in the classroom of the high implementer, and also indicated that the teacher had helped to raise the performance of students who may have been performing at a high, but not gifted, level (Maker et al., 1996).

- Multiple choice and open-response scores on state tests of science achievement were dramatically different for 10-year-old students in the classroom of a high level implementer of the DISCOVER curriculum principles when compared with the scores of children in two middle and low implementers' classrooms two years in a row (Year 1: [open response items] F=10.049, p=.000 [multiple choice items] F=5.516, p=.007; Year 2: F=4.177, p=.020) (Taetle & Maker, in review).

- Reading scores in the high and middle implementers' classrooms improved more than those in the low implementers' classrooms, but the differences were not as great as differences in science scores (Year 1: [open response items] F=2.536, p=.089 [multiple choice items] F=1.559, p=.220; Year 2: F=2.677, p=.076) (Taetle & Maker, in review).

- Students at a multicultural elementary school in the Southwest showed significant increases in Stanford 9 scores in the core subjects of language, reading, and math (from approximately the 18th percentile to the 62nd) from 1997 to 2000. The DISCOVER Projects were involved at the school from 1993 to 2000. In addition, an arts-infusion program coordinated with the activities of DISCOVER provided teaching artists to work with classroom teachers (reported in Maker, 2001).

- At an elementary school in an urban area in the Southeast, a DISCOVER Projects Magnet School, on the state tests of achievement, scores increased steadily in reading (from 40th to 60th percentile), math (from 22nd to 45th percentile), science (20th to 42nd percentile), and writing (9th to 42nd percentile) (reported in Maker, 2001).

- In addition to a high percentage of high implementers, certain characteristics are common to the schools in which overall increases were seen in creativity and achievement: (a) the principal's philosophy of education was similar to or compatible with the philosophy underlying the DISCOVER Project; (b) teachers at the school were involved in making the decision to participate in the project, and their decisions were made after having information about the project and its goals; (c) other programs implemented at the school were based on a philosophy consistent with DISCOVER and their goals were similar to the goals of DISCOVER (reported in Maker, 2001).

Current and Future Efforts

Studies like these continue. The most significant is an analysis of changes in student creativity, math performance, and written linguistic proficiency in classrooms of high, medium, and low implementers of the DISCOVER Curriculum model from the most recent project. We are developing and testing a new method for scoring the creativity test administered so that an acceptable level of inter-scorer reliability can be reached. Once this new system is in place, data have been collected about its effectiveness, and all tests have been re-scored, the analysis can be completed.

In a large project in another country, appropriate aspects of the DISCOVER Curriculum model (most notably the problem continuum and matrix) are being used in over 500 schools in a research and development project organized and carried out by a research team consisting of faculty at several universities. This project is nearing completion, and a report will be published. In another country, all the curriculum principles have been incorporated into a design merged with the work of a professor at one university. This professor, a colleague in a different country, and I have developed a new classification of human abilities that builds on research with DISCOVER and our combined experience in schools and with children in other settings. This new classification of human abilities is presented in the "Practical Applications" section, and it is being used in action research to design and test a new format for the DISCOVER Assessment. Materials developed based on this new theory and tested in three schools in England are included in Appendices D and E.

PART 3: Focus on Practical Applications

The DISCOVER Assessment

DISCOVER is a performance-based assessment of problem solving in four areas of ability: Spatial, Logical-Mathematical, Linguistic, and Interpersonal. It is based on a strong belief that people can make unbiased, valid judgments about the problem solving abilities of children from cultures similar to and different from their own. It also is based on a strong belief that children from all cultural, linguistic, and economic groups are gifted, and that they will demonstrate their abilities when challenged, interested, and encouraged to do so. Watching children carefully and attentively as they are engaged in problem solving is the very best way to learn about their abilities, and discussing children's performance with others is the best way to widen and polish one's own lenses, thus avoiding personal biases and stereotypes.

Problem solving activities are presented to the students, with tasks ranging from those with one correct answer to those with an unlimited number of answers and ways of reaching conclusions. Three activity sets are done in the elementary classroom and four in the high school classroom with observers watching and documenting the problem solving of students; two activities are done by elementary teachers prior to or before the observation, and one is done by high school teachers. The products of these activities administered by the teachers are scored by the assessment team or others who have been taught specific methods to score them.

The classroom teacher is given a brief orientation prior to the assessment, and is asked to give the directions for the activities. They are then involved and knowledgeable about the process, and the children feel more comfortable with the exercise. However, teachers are not observers because of their familiarity with students. Often, they have formed perceptions and stereotypes that hinder them from seeing the abilities of certain children. Teachers are asked to encourage, to use their normal management strategies, and to watch their children to see what they can learn about them. They are asked to refrain from assisting the students in any way. This is the task of the observers because they know what kinds of assistance (and the timing of such help) that is permitted. Teachers prepare the room, making sure students are in groups of 4 or 5 children, and that those who speak languages other than English are sitting together in language groups. They also prepare name tags for students so observers can quickly learn their names. A class list is provided as well.

Activity sets are different for certain grade levels: K-2, 3-5, 6-8, and 9-12. Activities are more difficult or complex depending on the developmental levels of students. The activity sets for assessing spatial ability are conducted first, and the oral linguistic is last in the elementary grades. At the high school level, after the spatial analytical activity, an interpersonal activity is included, and the oral linguistic activity is done at the end. Observers rotate to different groups for the different activity sets so they do not carry their expectations for students' performance (positive or negative) from one

activity to the next. Instructions are given in the languages spoken by the students in the classroom, with the English instructions given last. This practice gives a very clear message that other languages are valued in these activities. Children also are told they can use "any language they wish" as they participate in the experiences. Bilingual observers are assigned to groups of students speaking other languages, and if no bilingual observers with special training are available, translators can be substituted, but they will need an orientation with strong admonitions not to help the students, but to translate only what the observer and teacher say, and only what the student says when they give information back to observers.

Spatial Artistic

The first spatial activity, spatial artistic, is exciting and engaging to all students, and often is their favorite. At Grades K-8, each group is given a set of brightly colored cardboard pieces with abstract designs in varied shapes and sizes. At first, students explore the pieces, making anything they wish. The observers draw what they make and tell students "I would like to know about what you made." They also take a picture of the student and his construction, preferably with a digital camera. Next, students are given a specific form to make, and are shown a picture of what they are to make. These forms and pictures become less and less specific, and at the end students are told to "Make anything you want to make with as many pieces as you want to use. You can tell us about it if you want to." At this point, they also have plastic connectors, and can put the pieces together to make three-dimensional, very complex constructions.

At the high school level, because spatial artistic abilities are much more differentiated, and students have developed special areas of expertise and interest, varied materials are provided: art supplies such as pastels, charcoal, colored pencils and pens, various types of clay, various kinds of paper, watercolors, various brushes, materials for making mechanical toys (including batteries, wires, and connecting pieces), scissors, paste, tape, and other materials that enable students to make a variety of constructions. First, students explore the materials, then they are shown a variety of photographs and told to "recreate something in the picture" of their choice, and finally, are given the direction to "Make anything you want to make using any of the materials you want to use."

Spatial Analytical

In the second activity, spatial analytical, at all grade levels, the students are given a set of Tangrams. First, they are given some instructions for putting the shapes together to make different other shapes, and shown the concept of "trading" or substituting pieces. As these techniques are being demonstrated, students are asked to use them, so the observer knows they have heard, seen, and felt these methods. Next, they are shown a shape, and are told to make that shape with "as many pieces as possible." The shapes are more complex or difficult depending on the age of the students. Children in Grades K to 2, for example, are asked to make a square, a shape familiar to them. Observers note whether the shape is correct and the number of tangram pieces used to make it. After this,

students are given a puzzle booklet with shapes that can be made with the Tangram pieces. The pages in the booklet range from those that all students of a particular grade level can do to those that can be done by less than 5% of students at that level. Students must work each puzzle, as they may learn things on an earlier puzzle that will help with a later puzzle, and because they are arranged in order of difficulty. When they complete a page, they are told to proceed to the next page, and the observer notes the time the puzzle was completed, and the order (in the group) in which the puzzle page was finished.

After a child has worked on a particular puzzle page for 5 or more minutes, if the child seems frustrated, the observer can ask if the student wants a "clue" or a "hint." If the child wants a clue, the observer can give certain clues, and in a particular order, progressing from very general clues to more specific ones. Observers wait several minutes between hints, however, to see how the student uses the new information. Certain helpful ideas can be given at any time to a particular student or to the group. Students have a time limit for the activity that is appropriate to their age and developmental level. If they complete all six of the puzzle pages before time is called, they are asked if they would like to try a "challenge" page. If they do, it is given to them, and if they do not, they are told to "make anything you would like to make with the tangram pieces." Most choose the challenge page. In addition to recording the time students complete each puzzle, observers note which clues have been given and the problem solving strategies students are using.

Interpersonal

At the high school level, for the next activity, the students in each group are instructed to put all their tangram pieces together, and to make a certain shape with "as many pieces as possible." Observers watch their process, noting leadership, "followership," and other interpersonal behaviors. At the end of the activity, they ask students to reflect on the group's work and talk about their role and the roles of others. Interpersonal interactions for students in Grades K through 8 are observed during the spatial artistic and oral linguistic activities. Students are sharing a set of materials during the spatial artistic activity, so we can see how they share, how they negotiate to get a shape they need, and how some "snatch" a piece when another child is not looking! While they are playing with their toys to think of stories, when children talk, interact with the other students, and share experiences and materials, they demonstrate interpersonal problem solving behaviors. Observers take note of these interactions. Some interpersonal characteristics can be observed during the spatial analytical problem solving, but normally students are focused solely on working their own puzzles, so the best observations of interpersonal interaction are accomplished during the spatial artistic and oral linguistic activities.

Oral Linguistic

Next, at all levels, comes the oral linguistic activity. For children in Grades K to 5, observers distribute a bag of toys containing people, animals, a vehicle, and other things. The items in each child's bag are different, but all have 7 items of the same

categories. Children talk about their toys, and then tell a story about any or all of them. Observers record the stories with tape or digital recorders and encourage each child to tell a story. At the beginning of the activity, they ask which children speak more than one language, and they encourage those students to use both languages in their group work, or to choose whichever language they wish. When the observers ask students to tell stories, they ask the children who have indicated that they speak more than one language to tell their stories in both languages, and ask which language they would like to use first. Both stories are tape recorded and analyzed. If the observer does not speak the language, the story is evaluated by an observer or translator who does. Stories are analyzed in the language in which they are told, not translated and evaluated in English.

At Grades 6 through 12, the oral linguistic activity consists of showing 12 interesting, diverse, and provocative slides from various cultures and environments from all over the world. As they watch these slides, they make word charts recording their impressions of these images. Next, the observer takes out pictures that correspond to the slides, and asks students to choose one that is interesting to them. They are then to imagine they are in this picture, and tell about the experience. They also are given a bag of various concrete items and told that if they wish, they can imagine that some of these items also are in the scene, and include them in their story, poem, essay, news report, or other oral report of their experience in the picture. These products are recorded with tape or digital recorders.

Math and Written Linguistic

At this point, the students have completed the observed activities. The process usually takes 2 and one-half to 3 hours in elementary school, with breaks as needed between activities. At the middle and high school level, each activity is designed to be done in a class period or students can complete all activities in a group if the teachers and administrators wish to change the usual routine to free students for a larger block of time. At the elementary level and at middle school, the teacher can then complete the written linguistic and math activities or can wait until another day. The math exercises consist of computational problems ranging from those with one correct answer to those with multiple answers and methods for solution. The writing activity is open-ended, and students are instructed to write about anything they wish to write about, and in any form. This writing exercise also is done at the high school level, but at this time, we do not have a math exercise for high school.

Debriefing and Analysis

After the observers have had lunch and completed notes about their observations, they begin analyzing the performance of the students. Their analysis should begin as soon as possible after the observation so that important information is not lost. The most important guide they have for this analysis is the checklist of approximately 119 superior problem solving behaviors that were identified and classified during the initial and continuing research on the assessment. This checklist consists of behaviors that are observed as students are engaged in the activity (labeled as problem solving processes)

and important elements of the products students make (labeled as characteristics of products). First, the observers listen to the oral linguistic products, completing the checklist for the student as they listen. When all are ready, they then share their best linguistic products, discuss the students' processes as they participated in the activity, and develop certain stories as "marker" stories, to help each observer and the group decide what ratings to assign to all stories based on their quality—as defined by the characteristics from the checklist that they demonstrate. Observers continue with this process, establishing standards and "marker" products for each rating category, until all students' stories have been assigned a rating. Not all stories need to be heard by the group, but enough products need to be shared to enable observers to make consistent ratings across all groups of students in the class.

The next task is to complete a similar process with the spatial artistic products. If digital photos have been taken, they are downloaded to a computer at the school or office. Each observer chooses the best photo for each child for each of the activities in which photos are taken. Original products are evaluated for high school students. As observers review the photographs and their drawings, they complete the checklists for students they observed. When all are ready, photos and products are arranged on a large table, from the highest quality (as perceived by the observer who worked with a child) to the lowest quality. All observers view the photos and products, noting similarities and differences in quality. They discuss placement of the photos and other observations made during the process, and they reach consensus on the ratings to assign to categories of products and performance. Finally, they complete the checklists for students they observed during the spatial analytical activity, again determining the highest levels of performance and deciding where "natural breaks" occur in quality so that categorical ratings can be assigned to all students' performance. For high school students, debriefing also occurs for the interpersonal activity in a similar way.

Rating and Scoring Student Performance and Products

Ratings are categorical, and consist of verbal descriptions: "Wow!" is assigned to students whose performance is so far advanced that no others come even close. Very few of these ratings are given, and this category was created for the "outliers" whose performance would skew the ratings for the group and prevent other gifted, but not as outstanding, students from being identified. "Definitely" a superior problem solver is assigned to the top group of students. No particular number or percentage of students should get this rating. The decision is made by observers based on the items in the behavior checklist. "Probably" a superior problem solver is assigned to the next level, "Maybe" to the next level, and "Unknown" to the lowest level. "Redo" is given if the observers and teacher agree that a particular student did not have an appropriate opportunity to demonstrate her or his ability. Reasons could include such things as the student being sick, being called out of the room during an activity, having a major conflict with another child in the group, or the student's photos or oral stories were lost due to technological difficulties.

Math worksheets are scored according to pre-determined criteria, which include both accuracy and the use of concepts and problem solving strategies. Written linguistic products are rated using a holistic scoring process, and involving at least two readers. One reader reads all the products from a class, noting important traits of stories, poems and other forms. Next, this reader reads them again, this time placing them in (usually four, corresponding to the four categories of ratings) stacks based on overall quality (as judged by the presence of the superior problem solving behaviors on the checklist). Each stack is re-read, and any that do not seem to fit into the category are moved. A rating is recorded on a form prepared for this purpose, and the form is folded so the second reader cannot see the ratings. The products are shuffled, and are given to the second reader, who follows the same process. If, after comparing the ratings, there are no differences, the ratings are recorded, and the raters complete the behavior checklists for the students. If disagreements exist, readers must discuss and attempt to reach consensus on the ratings. Since most disagreements are on only one category higher or lower, readers usually reach consensus and the process is complete except for the checklists. If readers cannot agree, they prepare a packet including marker stories for the categories in dispute, and give the packet to a third reader. The third reader usually agrees with one of the other readers, and this is the rating given. If her or his score is completely different, the three meet and come to consensus on the rating, and checklists are completed.

Identification of Gifted Students

Now, decisions can be made about which students to identify as gifted. This decision is not usually made by the entire team of observers, but by a coordinator or other individual(s) responsible for placement. Materials available for making these decisions include a completed behavior checklist for each student with a summary page showing ratings for the student across all activities, photos of constructions, oral linguistic products, math worksheet, and written language sample. A summary sheet including ratings for all students also is available. Usually, decisions are made based on the number of "Definitely" or "Wow!" ratings a child has received. However, sometimes it is important to think of the rating of "Probably" in a supporting or different area. At this point, the individual or team responsible for identification and placement must consider the type(s) of programs available and the percentages of students who can be served in these programs. In general, we have found that approximately 26% of students receive a "Definitely" rating in at least one activity, 14% get a rating of "Definitely" in at least two activities, 5% get a rating of "Definitely" in at least three activities, 1.8% are rated "Definitely" in at least four activities, and .3% receive the highest rating in all five activities. If decisions based on only these ratings are difficult, a committee can review all materials available, and can certainly collect more information to supplement the assessment results.

Observer Development and Certification

To be a valid and consistent measure, an assessment must be conducted in the same way with all students; therefore, observers must learn certain procedures, and must follow them consistently across all children, classrooms, and schools. They also must

learn how to recognize a wide range of superior problem solving behaviors, and how to think in positive ways about the children and their abilities. Thus, observer development, certification, and updating are essential to maintaining the integrity of the assessment. Observers participate in 5 days of initial development, including an overview of the philosophy and framework of the assessment, experiencing the activities, reviewing the research on its development and implementation, and conducting a practice assessment in a classroom in their school district. After they have had an opportunity to do at least 4 assessments, but no more than 8, they are observed and evaluated as they conduct an assessment, and if competent, receive "certification." To keep this certification, they must participate in updates conducted at the local level or at a state or regional level, particularly when important changes have been made to improve the assessment. School districts are encouraged to develop a cadre of observers, which can include retired teachers, community members, and teams of teachers of the gifted as well as special education, bilingual education, and regular education. They also can designate an expert observer who will continue learning and become a "certified" assessment trainer, providing observer development activities for the district, and later, possibly for others outside the district. Periodic updates are provided for assessment trainers.

The DISCOVER Curriculum Model

The DISCOVER curriculum model integrates principles from cognitive science, as outlined in Bransford and colleagues' (2000) recent review. These principles are merged with principles derived from writings in education of the gifted (Maker, 1982; Maker & Nielson, 1996; Maker & Schiever, in press), applied within the framework described in this monograph, and used in the daily teaching of all students. Although designed to be implemented in the general classroom setting, the model can be applied to teaching in any setting—a special class for gifted students, a resource room (pull-out program), a special school, a program for twice exceptional students, a special education program for students with handicapping conditions, university-based programs, teacher education programs, staff development, and any other educational programs.

We begin with the premise that all students, even those labeled "at-risk" are really "at-promise" for success due to their problem solving abilities in some area. Students' strengths are identified using the DISCOVER assessment as well as interviews with children to gain insight into their views about themselves. Interviews can be a short as 15 minutes, but often teachers find they want to spend about an hour at the beginning of a school year with individual students. This may sound time-consuming, but it is well worth the time spent, and actually saves time later. Discovering more about each student continues through observation, especially during open-ended problem solving and the cooperative development of portfolios or work samples. Other means of finding out about children are interviews with parents and visits to their homes and communities. The simple fact that a teacher will visit the home or community of a child from an impoverished family can make a world of difference in that child's commitment to learning and his comfort in being in your classroom!

In the next sections, I review the six principles derived from observing classrooms of the teachers who attempted (at different levels) to make the framework of DISCOVER practical, and give examples of how these principles were implemented. In Appendices F, G, and H, are three teaching units based on these ideas: One was developed and taught in a regular third grade classroom in a school with a high concentration of Mexican American students, many of whom came from low income families; the second was developed for a pull-out program for gifted students in a multi-cultural school district with students from varied ethnic and economic backgrounds; and the third was developed and taught in a high school language arts program for gifted students in a multi-cultural, urban school district.

Principle 1: Integrates multiple intelligences through self-selected product formats, available/accessible tools, and choices based on interests and strengths.

This principle has three main parts: product formats, tools that are available and accessible, and student choice. What we mean by self-selected product formats is that the child is allowed to decide (not always, but a significant part of the time) how to "show what she knows" using varied product formats or combinations of formats. I will never forget the wonderful experience of watching first grade students in one of our classrooms as they found different ways to show what they had learned about natural habitats. Their focus was on the ocean as a habitat. One little boy created a beautiful watercolor painting with various ocean creatures, one wrote a story about a fish that lived in the ocean, another created a puppet show with several creatures involved in a food chain, another demonstrated through creative movement how an octopus would move in the ocean, and another built a desert habitat and told how it was different from the ocean habitat.

When children are given such choices, the varied tools needed for their constructions must be available and accessible. Teachers often have learning centers around the periphery of the room that contain these tools, and students are free to use the materials for their creations. Following is a list of materials one primary teacher had in her classroom. Some materials are appropriate for all ages of students, and others only for young children. Similar materials can be provided at other grade levels, and a "center" can consist of a "Rubbermaid" container that can be put away in a cabinet when not in use. *Linguistic:* hand and finger puppets, miniature objects, picture books, tape recorder, blank tapes, books on tape, writing supplies (paper, markers, and/or chalk), books or stories written by other children. *Logical-Mathematical:* Tangrams, attribute blocks, puzzles of a variety of difficulty levels, Unifix cubes, a water/sand table or plastic container that can hold water, measuring cups of different sizes, funnels of various sizes. *Naturalist:* magnifying glasses, microscope, natural objects such as sea shells, rocks, insects, leaves, books for identifying natural phenomena. *Spatial:* tissue paper, drawing paper, construction paper of varied colors, colored markers, colored pencils, watercolors, chalk, scissors, glue, a collection of "junk" and recycled materials such as Styrofoam "peanuts" and plastic bottles, scraps of various fabrics, clay, Play-doh, wooden blocks, brushes, things to take apart and put back together, rectangles of cardboard. *Musical:* music on tapes or CDs, tape or CD player, household items that make different sounds, glass bottles to fill with water, rhythm instruments, keyboard, xylophone. *Bodily-*

Kinesthetic: dress-up clothes, bubble maker and soap for bubbles, mirrors, pictures of dance movements and Yoga positions, videotape of traditional local dancers and dances, large balls, jump ropes. *Interpersonal/Intrapersonal:* blank books, individual sized chalk boards or white boards with appropriate writing instruments, soft places to sit with others, miniature objects, a play kitchen, books about families, pictures of families.

Students are given as many choices as possible within State and National curriculum standards. As you can see from reading the units in Appendices F, G, and H, many choices can be provided within any framework. These choices are made from product formats, type of problem solving, complexity of project, interest areas within a topic, whether to work alone or with others, and when or how to share products and learning processes. Students of all ages and backgrounds can and should make choices about their own learning. Collopy and Green (1995), for example, have found that when students have opportunities to set learning goals matched to their interests and strengths, they undertake more challenging tasks, use more complex thinking skills, persist in solving more difficult problems, and are less threatened by mistakes than if all students had the same task and success was defined by comparing their scores with others. Learners are more engaged when activities are varied, when they have choices among tasks, when they can learn through varied symbol systems, and when they interact with peers in problem solving and product creation.

Principle 2: Poses a variety of types of problems and, at times, encourages students to design their own problems, to access information and demonstrate understanding.

At the heart of the DISCOVER curriculum is development of a "problem solving matrix," which is a set of problem solving experiences based on domains of ability and the continuum of problem types designed initially for the studies of problem solving in children and adults. Within each domain of ability, people can merely adapt to the world around them and solve problems in ways they have learned, or they can also conduct research on the frontiers of knowledge, thereby making new advances and creating new innovative products. In the DISCOVER Project we have made ideas from the framework of DISCOVER more practical by using a continuum of problem solving situations derived from our teaching experience and from the work of researchers in creativity.

In our model, problem-solving situations are categorized according to whether the problem, method, or solution is known by the presenter or the solver. Getzels and Csikszentmihalyi (1967, 1976) used three problem types, and we added two to complete the gap between their first and third. In our model (Maker & Schiever, in press; Schiever & Maker, 1991, 1997), the first type is one in which the problem and method are "known" by the presenter and solver, and the solution is known only by the presenter. The solver's task is to apply the known method to reach the solution already known by the presenter (i.e., the teacher or the author of the test). In math, for example, 4 + 7= ___ is a Type I problem. The second type is close to the first in structure, with a problem known to the presenter and solver, and both method and solution known to the presenter but unknown to the solver. Again, in math, a Type II problem can be a word problem such as "A farmer bought six hundred bales of hay for his 30 cattle. In a rainstorm, half

of these bales of hay were ruined. How many bales of hay does he have left?" The third problem type has multiple methods, but only one correct answer. Another word problem could be presented: "In Pima County the percentage of land use is the same as that in Maricopa County (Students have been given or were asked to calculate the percentage of land use for various purposes in Maricopa County). Farms and ranches in Pima County occupy 500,000 acres. How many acres are occupied by Big Lake (the only lake in the County)?" This problem can be solved using many strategies, but it has only one correct answer. In the fourth problem type, more than one method and more than one solution are acceptable. However, the methods and solutions are known to the person presenting the problem. An example from math is to give students 3 different numbers—2, 5, 3—and ask the students to write correct addition and subtraction problems using only those numbers. They can use two different methods and can reach four different solutions. The fifth problem type has a clearly defined problem, but an unlimited number of methods and an unlimited number of solutions can be identified or developed. The person presenting the problem does not have acceptable methods or solutions in mind. If you give students any number, and ask them to develop as many problems as possible with that number as the answer, the number of possible methods is unlimited, as is the number of appropriate solutions. The sixth problem type is one in which problem, method, and solution are "unknown" by both presenter and solver. A math problem situation of this type is to "choose a number, an operation, or any other math idea, and show it in as many ways as you can." In Type VI problem solving situations, the problem solver must define the problem to solve before attempting to solve it. This type permits the most individual creativity, and requires the ability to "find" or "define" a problem contained in a situation. Types I, II, and VI comprised Getzels and Csikszentmihalyi's (1976, 1967) original matrix; Types III, IV, and V were added by Maker and Schiever (Schiever & Maker, 1991, 1997) so the Types could be perceived as being on a continuum of decreasing structure.

Types I and II require mostly what is often called convergent thinking, or knowing the correct solutions and methods, while Type III begins to require more of what is usually called divergent thinking or creativity, and Types IV, V, and VI require and develop the most creative and productive thinking. However, even these open-ended problem solving situations continue to require convergent thinking because the individual eventually must decide which idea or ideas to use. Many examples of the problem matrix are provided in various publications (see Maker & King, 1996; Maker & Nielson, 1996; Maker et al., 1994; Maker et al., 1996; Maker & Schiever, in press; Wallace, Maker, Cave, & Chandler, 2004), and in the appendices (F, G, & H) of this monograph.

The classroom teacher uses the matrix to develop learning activities, and helps students choose learning experiences. Students also can learn about themselves by analyzing their choices of learning experiences. Each activity in the matrix is designed to do two things: develop higher competence in the intelligence and develop an understanding of the academic content being taught. Teachers can use the problem matrix they have devised in many different ways, depending on their willingness to allow students to make their own choices. At the very least, however, students will be able to choose what problems to solve when they work on Type VI Problems (due to the nature

of the problem type), and will be able to select their own methods and devise their own solutions to Type V problems. Some of the activities in the matrix can be done as whole-group activities and some of them can be assigned to certain small groups of students, and some can be optional activities students find in the learning centers or choose from a list of optional activities. Some teachers develop a problem matrix and make all the activities optional, while others may require that all students do the Type I and Type II problems to ensure that each student experiences all areas of ability and learns certain required content, but allow students to "specialize" by choosing to do the Type III, IV, V, and VI problems in one or two areas of their choice. The matrix is not intended as a list of activities to be completed by all students.

As students are analyzing their own choices and keeping records of which problem types and which intelligence areas they tend to prefer or do not enjoy, they also can be encouraged to design their own investigations and problem solving experiences. I always enjoyed watching Randal Pease, a DISCOVER targeted teacher in a small, rural school district in Southern Arizona, introduce a unit in his fourth grade class because he involved his Mexican American students (many of them second language learners) in meaningful ways in the creation of their learning experiences as well as in the final evaluation of their learning. I describe more of his classroom in the following section.

To develop each of our abilities to its full capacity, and, I would add, to increase the capacity of our nations to contribute in a positive way in our increasingly interdependent and complex world, we must emphasize and develop our children's ability to solve a variety of problem types. We must not restrict their work in school to solving problems with right answers and known methods, and then expect them to go into the world and suddenly become capable of creating new products and generating new ideas. Don't forget, either, that emphasis on open-ended problem solving is essential for those who are the most highly competent in a particular area—math, writing, speaking, dancing, athletics, science, engineering. Highly competent people of all ages are motivated and interested if given the challenge of struggling with an unstructured, and often complex, problem rather than one they know already has been solved.

Principle 3: Collaborates with students to establish a learner-centered environment that includes student choice, flexible schedules and grouping, standards for behavior, sharing, openness, and acceptance.

Teachers implementing the DISCOVER curriculum model developed different levels of involvement of students, based on their levels of comfort and willingness to allow students to be responsible. In Randal's classroom, they had a high level of responsibility. As he introduced a unit he told them they would be studying a particular topic—cultures of the Southwest, for instance—and that he wanted them to think about the many ways they could study it. He began with large pieces of newsprint with only a title: Interpersonal, Intrapersonal, Linguistic, Logical-Mathematical, and the names of Gardner's intelligences. He asked the students to think of ways they could learn about the cultures of the Southwest.

In small groups, the students made lists of what they could do, and then each group reported its ideas. The whole group thought about the ideas and decided which intelligences would be involved in each way of studying the topic, and they eventually decided where he should write the idea (sometimes ideas were listed in more than one place, and sometimes they were written so they fit mostly in one category). Next, the students thought of ideas for the areas with only a few or no ideas listed. After this discussion, Mr. Pease again asked small groups to write additional ideas for studies. This time, he told them to think about ways to learn that would develop their knowledge as well as ways to learn that would develop their creativity. In the small groups, these were written on "Post-It" notes and later placed on the appropriate poster. He left the posters on the walls, and students could add other ideas as they thought of other ways to learn. Students could choose one of the methods during choice time, and he encouraged all of them to select at least one of the long-term "creative" projects to work on during the whole unit.

In Lori Stewart's third grade classroom on the Navajo reservation, after talking about the different ways students could learn and the different ways they could "be smart," she asked how they would like her to teach and to organize the room so that they could learn better. They decided they would like to have different kinds of "stations" where they could go to learn more. They were very clear that they wanted her to design the things they would do in these stations because designing activities was too much for them, and after all, she was the teacher and it was her job! They wanted to rotate through these stations so all would have an opportunity to experience all of them. She was to set a timer to ring after a certain number of minutes so they would know it was time to move to the next place. They wanted many materials, books, games, and other things to use to learn. As time went on, they also decided to set up a "study hall" or place where they could go if they were not able to finish what they were doing in a certain station when the timer buzzed to let them know their time was up. Later, they became more flexible about their movement through the stations, and wanted to have more time for each and to have certain days when they could choose to do only one or two. They found they sometimes became involved in something and didn't want to stop and go on to another station.

When students experienced problems with others or with the structure, Lori held discussions with them, using a form of Creative Problem Solving to look at the problem from several points of view, and then brainstorm many ways of solving it. They then listed criteria for judging these ideas and selected the solution that seemed to have the most potential for working. Randal used a similar process with his students, and says that they often came up with stricter solutions than he would ever have imagined imposing, but that since they had decided on the plan of action, he usually had no difficulty getting them to follow it. Both classrooms had a list of rules or standards of behavior the students had generated near the beginning of the school year. These were posted in the room, and were re-visited when students had problems or solutions that didn't seem to be addressed by the standards.

Principle 4: Organizes content around broad-based, interdisciplinary themes.

To unify learning and ensure that all students understand the interconnectedness of learning, the DISCOVER curriculum model includes experiences organized around themes that are developed through many content areas—big ideas that cut across fields of learning and inquiry: systems, patterns, change, conflict, communication, relationships, culture, structures, cycles, exploration, conflict, invention, interdependence, environments, diversity, beauty, ethics, harmony, or others that lend themselves to including the concepts and skills from the State, Local, or National curriculum. An important point to emphasize is that we are not recommending teaching extra things or leaving out what is expected in the Standards teachers are asked to follow. We are simply talking about *organizing* the learning in a different way. Instead of organizing a unit of study around factual material such as "the desert," the teacher organizes the unit around "habitats," and the information students are learning about the desert is put into the larger context of habitats in general. They contrast their desert habitat with other habitats such as oceans and rain forests, and in so doing, they achieve a deeper and broader understanding of the desert while also learning important principles and generalizations that apply to many different habitats. (See Beatriz Ruiz's unit in Appendix E for examples of how learning was organized around this theme and at the same time addressed the Arizona State Standards in several different content areas.)

Another important reason for using themes to organize learning and to design a problem matrix is to focus on bigger ideas and projects rather than to find eight ways to teach a skill or fact. Teaching facts or skills in "eight ways" is repetitive and boring for both the students and teachers, and I believe is one of the major reasons why some educators of the gifted are opposed to curriculum design and teaching supposedly based on multiple intelligences. I don't believe this kind of teaching is what Gardner envisioned at all when he proposed the theory. I really believe he had in mind something with more depth and choice than has been presented by popular speakers and writers on the topic. Regardless of what he intended, we found, through working closely with many excellent teachers, that the use of thematic teaching—when themes are defined as big, interdisciplinary ideas, not something concrete like "bats" or "dinosaurs"—can help teachers and students deepen and extend their learning while acquiring the information and skills they are expected to learn. Incidentally, a better theme to use if students are interested in dinosaurs is "extinction" and one possible theme to use if they are interested in or need to learn about bats is "cycles." For gifted students, movement beyond facts and concepts is extremely important, so they can develop abstract ideas, generalizations, and theories to apply and challenge their thinking about complex or seemingly unrelated phenomena.

Principle 5: Models a variety of processes and gives students opportunities to use the processes to access and transform information.

One of the things that strikes me as inappropriate in the popular application of Gardner's and other multiple talents or multiple intelligences theories is that some practitioners and writers never seem to go beyond the surface of the theory or the

understanding of different abilities. These practitioners and writers seem to lack depth in understanding each ability (or intelligence) and how the abilities interact. Even the problem matrix we designed can create an artificial distinction between types of abilities. I still recommend that teachers create these matrices, at least initially, because they can see more easily the many ways each ability can be developed. In other words, some teachers have to separate abilities before they can combine them in appropriate ways without losing the essence of one or both.

Going beyond the surface means thinking carefully about the processes, products, and knowledge needed in each area of ability—reviewing what Gardner and others identify as important core capabilities and processes, re-reading Sternberg's descriptions of metacognition, analytic ability, synthetic ability, and the ways they interact. Here are some examples: *Spatial* intelligence doesn't just include drawing things or using one's visual abilities. It includes perceiving the visual world accurately; performing transformations and modifications upon one's initial perceptions; recreating aspects of one's initial visual experience in the absence of the actual physical thing, recognizing instances of the same element; transforming or recognizing a transformation of one element into another; making mental images and then transforming those images; and producing graphic likenesses of spatial information. Considering some of Sternberg's ideas can broaden (or deepen) the kinds of experiences provided for children to develop their spatial ability. For example, in the domain of spatial ability, artistic expression usually is synthetic, while making a graph is analytic, and fixing an engine is a practical use of spatial abilities. *Linguistic* ability includes sensitivity to the meaning of words; sensitivity to the order among words; sensitivity to the sounds, rhythms, inflections, and meters of words; and sensitivity to the different functions of language. Linguistic ability also includes being able to learn and apply the social and grammatical conventions of a particular language or to know how these rules can be violated without compromising the message!

Teachers also need to go beyond the writing and research of any one theorist and include the results of extensive experiences in teaching, assessment, or research. Gardner lists only one core capability for *interpersonal* intelligence: to notice and make distinctions among other individuals (e.g., moods, temperaments, motivations, and intentions). We see, during the DISCOVER assessment, that interpersonal abilities include patience with others, ability to see another's point of view, showing pleasure when others succeed, ability to organize activities and people, making positive comments about others' performance, and encouraging others. *Intrapersonal* ability, too often, is seen only as a desire to work alone! It includes much, much more than that, and work such as that by Mayer (Mayer, Perkins, Caruso, & Salovey, 2001; Mayer & Salovey, 1997; Mayer, Salovey, & Caruso, 2000; Mayer, Salovey, Caruso, & Sitarenios, 2003) and Goleman (1997) on emotional competence are important examples. Intrapersonal ability goes beyond even an understanding of ourselves to include the ability to manage our emotions and feelings—to release negative emotions and let go of our resentment toward others we feel have harmed us.

Implementing the DISCOVER Curriculum framework also includes developing an understanding that abilities and intelligences are separate to a certain extent, but also related, interacting, and interdependent. In one of our case studies, a jazz musician described how he wrote poetry during the linguistic tasks we presented. He repeated the words to himself or out loud, focusing on the sound and rhythm pattern of the combinations of words instead of their meanings. Although a core capability of linguistic intelligence is sensitivity to the sounds, rhythms, inflections, and meters of words, he essentially ignored other processes of linguistic intelligence such as meaning, order, and function. His *musical* core capabilities—sense of rhythm, heightened aural awareness and sensitivity, and aural imagination were more dominant in the way he wrote poetry than were his linguistic ones. Great storytellers, as another example, need a high level of interpersonal ability, enabling them to relate to their audiences, and can draw on their ability to access their own feelings and use these feelings to guide their actions as they find ways to relate to their audiences.

This brings me to another aspect of implementation of this principle of the DISCOVER curriculum framework: arts integration. Each of Gardner's intelligences is directly related to several types of art, and three of them are art forms by definition: musical, bodily kinesthetic, and spatial. Both Sternberg and Ceci recognize varied areas, including these art forms. Therefore, arts integration needs to be an important part of the curriculum. Bodily-Kinesthetic abilities can be honored and developed through the use of mime, dance, and theatre. Spatial abilities include sculpture, painting, design, architectural forms and structure, and computer-enhanced imagery. Teachers can't be expected to be experts in all art forms! That's why it's so important to invite experts and artists into the classroom to model and teach their passion. As I watched my good friend and colleague, Darrell Anderson, an accomplished watercolor, pastel, and oil artist, work with the Navajo and Mexican American students in our first project, I was convinced that we need to cultivate more connections between artists in local and remote communities. The Navajo students were fascinated by this African American man, and surprised to learn of his abilities. They loved his crazy personality, and they watched carefully every stroke he made as he demonstrated new ways to use charcoal and pastels. The kindergarten children watched in rapt attention as he showed slides of his art, and also paid careful attention to the techniques he demonstrated. I saw many of them trying his techniques during the exercises after his demonstrations. Perhaps even more important to the African American children in the group, however, was that this man was a successful practicing artist, and he was teaching them. Many had never seen an African American teacher or artist, and working with him was a powerful experience. Many artists have developed ways to help teachers teach academic content through the arts so that teachers do not feel that the arts are "extra" and only to be taught after the required content is covered.

Finally, teachers need to model the processes and behaviors they expect children to learn. Teachers are lifelong learners as well as teachers. Share your experiences as you take a class at the university, ask students for help with your problems, and show them how excited you are about your new (or old) hobbies!

Principle 6: Encourages students to develop varied products that reflect the diverse strengths, interests, and preferences of students.

The most important way to implement this principle is to integrate the cultures and languages of the children in the classrooms and schools into the learning process. This includes some of the usual showy methods such as celebrating "Cinco de Mayo" (which, by the way, is not celebrated in Mexico!) and other ethnic holidays, or cooking food from different countries. Even more important are some of the more subtle ways of including different languages and cultures.

- Include materials written in other languages.
- Study important historical figures from different cultures and authors from the cultures of the children in your classroom.
- Read material written from a different culture or country's perspective, such as the Mexican perception of the Spanish Inquisition or a Navajo perception of the "Long Walk." How about the Navajo code-talkers' views on the World War?
- Have a clay center in a kindergarten classroom (clay and the processes of making items from clay are very important in Navajo culture).
- Have a grandmother or other elder come into the class to demonstrate rug-weaving or clay work.
- Have a local Piñata-maker demonstrate his art.
- Have a lesson on making tortillas or fry bread.

Don't forget bilingual instruction and other subtle ways to send messages that more than one language is valued and respected, not a cause for shame.

One really fun way I saw this principle implemented was in a high school English class. The teacher was teaching descriptive, expository writing. This was the appropriate time of the year for string games in the Navajo culture, and everyone was playing and teaching them. The English teacher based her teaching unit on string games. The students created games, and then wrote descriptions of how to create their elaborate constructions. They exchanged their written descriptions with another person and watched while the other student got hopelessly lost and tangled in the string because their descriptions were not clear. They discussed ways to improve their descriptions, and tried the revised explanations on another person. Finally, they sent photos and written descriptions to the Mexican American students in some of our other schools, and those students, unfamiliar with string games in general, also tried to follow the directions. Some classes even videotaped their attempts, and this was a source of great fun for students in the English class! More revisions were made, and the students praised their teacher for helping them have fun and learn so much about writing.

Upon entering a class or school, if I see drawings or paper cuttings that are all alike on the walls in the hallway or on the bulletin boards in the classroom, I feel tremendous pain! Too many times, teachers cut paper models, and the only thing the students do is paste the precut materials together. Perhaps you think I shouldn't have to

address this problem; however, it is surprisingly common in early childhood classrooms. Products in the school and on the walls of the classroom need to reflect the interests, diverse strengths, varied perspectives, and preferences of the students in those schools and classrooms. Perhaps children are not accomplished artists, but looking at their art is much more revealing of their thinking and knowledge than looking at how well they put together the materials cut by the teacher. If they draw or construct something themselves, they have to pay a lot more attention to the attributes of the model than if they simply glue some pieces of paper together. Story starters also are problematic. Children *can* think of things to write about, and one of the reasons they start having trouble thinking of subjects is that so many teachers use story starters or prompts. As a result, children become lazy thinkers, depending on the teacher for ideas. I often use the example of Melissa, a third grade student who wrote a one-line, boring ending to the starter "If I were a monkey, I would . . . ." Actually, she didn't know what a monkey was, and she certainly wasn't interested in imagining being a monkey. When told she could write about anything she wanted to write about, and could use any form she chose, she wrote a striking poem about autumn leaves.

Since I started with Randal's fourth grade class, I'll end with it, and tell about how he evaluated his teaching unit on "cultures of the Southwest." Several days earlier, he had told students to be prepared for a test on the unit. Before the students arrived in his classroom the day of the "test," he pushed all the desks, tables, and chairs to the sides of the room, and put plastic boxes of materials in the middle of the room. These boxes contained materials similar to those listed as "tools" of the different intelligences. When students entered class that day, they were told they would have most of the day to "create something that shows what you have learned about the cultures of the Southwest." The excitement and engagement in that room were amazing. I didn't see anyone resting, bothering others, or doodling. All the students worked constantly, happily, and diligently on their products. Some worked alone, some worked with another person, and others worked in groups. They also knew they would have a class meeting in the afternoon, and all would have an opportunity to present and share their creations.

I watched the creation of a new song, complete with lyrics and melody, various paintings, a complex design burned on wood, a dramatic production of a ceremony, a collage of photos cut from magazines, a Styrofoam sculpture of an important historical event, and several stories. As the students explained how they created their products and talked about what these products meant, I could see that each was personalized, and that it not only showed the students had learned important information, but also that they had thought deeply about this information and what it meant to them. One girl spent most of the day standing around looking regal, holding a tablet, and wearing a sort of Toga she had made for herself. Finally, I couldn't contain my curiosity, so I asked what she was doing. She said she was the Statue of Liberty. I wondered out loud what a statue would do, and she told me she was "welcoming people into this country." By the end of the day, she had written a beautiful, moving essay about how the early immigrants from Europe must have felt when they saw the Statue of Liberty welcoming them to this country. What a different feeling the Mexican people have as they sneak across the border and watch many of their friends and family members die of thirst in the hot Arizona desert!

Randal's class was certainly a place where I could learn first-hand how to help students create varied products that reflected their diverse strengths, interests, and preferences. Both the achievement and creativity scores of these students that year and the following year reflected their unique learning experience.

Summary

Please keep in mind some final thoughts. If you wish to serve students from culturally, linguistically and economically diverse backgrounds appropriately, implement new and innovative programs in your schools, and expect to show positive results, several factors must be present: (a) the instructional leader must believe in the program and give it support, (b) a "critical mass" of teachers must believe in the program and use it in their assessment and teaching on a consistent basis, (c) all teachers and paraprofessionals must be informed and must develop competence in using the model you select together, and (d) you must choose other programs that are compatible. To do so effectively, I also believe many of us must change the way we think about assessment, teaching, and all of education—from an emphasis on teaching facts and information to developing abilities, talents, and problem solving in multiple domains! Remember the words of the great thinker Albert Einstein: "The world we have created is a product of our thinking; it cannot be changed without changing our thinking."

Putting the Assessment and Curriculum Models Into Action: Six Brief Case Studies

In this section, I describe several schools, school districts, school district cooperatives, and states in which either the assessment or curriculum model or both are being implemented. I provide as much detail as possible to help others see how they could use the models to resolve problems in providing appropriate services for underrepresented students. However, names and other identifying information are not given because administrators change and often programs change with them.

Schools

An Inner City Elementary School With African American and Caucasian Students

School A, a struggling Pre-K to Grade 5 school in an inner city, adopted the DISCOVER assessment and curriculum model. Under the leadership of a dynamic principal, teachers assessed all children with the new instrument and all teachers worked to modify their teaching to include problem solving in multiple domains. Teachers interested in the assessment received training, and substitute teachers were provided to allow them to conduct assessments in all classrooms. The first year, a team of teachers assessed all students in the school at Grades K-4. Each classroom teacher was provided with information about the strengths of the students in the classroom. In subsequent

years, incoming kindergarteners and new students were assessed, and each year, information from initial assessments was provided for the classroom teacher and other specialists working with the child.

In addition to implementing the principles of the DISCOVER Curriculum model in all classrooms, two schoolwide programs were developed. In one, all upper-grade students were offered DISCOVER classes at the end of every day for an hour. Every 6 weeks (each new grading period), new classes were offered. Students and their parents could choose the classes, but students were encouraged to select classes in their areas of strength from a variety of exciting choices: photography, a study of insects, newspaper reporting, making videos, creative writing, creative dance, creative drama, instrumental music, rocks and minerals, African Dance, Ballet, Jazz, painting with watercolors, using pastels, sculpture, hands-on math, and many other choices based on the hobbies and specialties of teachers, para-professional staff, parents, and community members. A second program was a modified pull-out program for identified gifted students at all grade levels. Students could come to a special room to either work on activities organized by the teacher or work on projects they had begun in the regular classroom, but did not have time to complete. They also could initiate long-term studies or projects of interest to them. The teacher provided guidance, materials, other resources, encouragement, and support for the students.

An Elementary and High School in a Rural Area on the Navajo Reservation

Two schools, an elementary (K-8) and a high school (9-12) that serve Navajo students in both a boarding school and day school setting have implemented the DISCOVER Assessment to identify gifted students. Many students speak Navajo as their first language, and most are from low-income homes. All live in remote rural areas on the reservation. The Bureau of Indian Affairs (BIA) supports the use of DISCOVER as it considers the assessment a consistent, fair, and equitable measure of children's abilities. All BIA schools receive additional funding for each child identified as gifted, so the initial training costs can be recovered when students are identified. At both schools, teacher teams with certified observers conduct the assessments. During the first year of implementation, at the elementary school, all students were assessed. In subsequent years, only entering kindergarten students have been assessed. Children are identified as gifted based on "definitely" ratings in the categories of ability defined by the BIA, and those identified are placed in content-based social studies and science classes offered by a teacher with a master's degree in education of the gifted. This teacher works closely with other teachers to modify instruction to meet the needs of children placed in the special program and also helps them teach to the strengths of other students in their classrooms based on the children's assessment profiles. Social studies and science were chosen as the subject areas for the special program as these content areas were seen as ones in which the differing abilities and talents of students could be developed. Regular classroom teachers were more accepting of the students being taken out of their classes for special instruction because they were learning specific content. Many of the teachers viewed the students as having deficits that needed addressing rather than as students

having talents that needed to be developed—and indeed, the students have both talents and deficits.

The teacher of the gifted also is the coordinator of the DISCOVER Assessment, and has received further instruction in the assessment so that she can be a "trainer" of additional observers, thus minimizing the cost of new assessment training for the school. She received this additional instruction and practice through her work at her own school as well as with other schools in the local area.

At the high school, each year, only the entering freshman class is assessed. This decision was made initially because of the newness of the program and a desire to provide an appropriate program for the students identified. Each year, new services were added to serve students as they moved through the school curriculum. Services for identified gifted students are provided mainly in the regular classes through modifying assignments, and changing the curriculum to allow for projects in the students' areas of strength and interest. When a student is identified, an Individual Educational Plan (IEP) is designed. In this IEP, the services and curriculum differentiation for the student are described, including the goals of the services, classes in which the student will be placed, and ways the curriculum and assignments will be modified. Monitors from the BIA read these IEPs carefully, and sometimes check to see that service delivery and curriculum match the written IEPs.

Sometimes, when certified observers feel they are too overworked to conduct assessments, the school contracts with the University of Arizona to bring a team of qualified observers to conduct some or all of the yearly assessments. This arrangement has been a useful way to update the school's assessment teams (by participating with observers from the U of A) as well as to help university personnel and students understand Navajo students and culture.

School Districts

A Large Urban District in the Southwest

In this school district with a large population of Mexican American and Native American students, and a smaller population of African American and Asian students, the DISCOVER Assessment has been used as one of several measures to increase the participation of underrepresented groups in programs for the gifted. Other measures and procedures include tests on the State approved list, the Standard and Coloured Progressive Matrices (Raven et al., 1988; Raven et al., 1977) for those whose primary language indicators are other than English, a teacher checklist based on a modified version of Mary Frasier's key characteristics of gifted students (Maker & Nielson, 1996), a placement team that considers diversity factors, and the DISCOVER Assessment.

DISCOVER is used at schools with large populations of high minority, low income students. All kindergarten students in each school are assessed by a district team

of certified observers, individuals who are itinerant teachers of the gifted, bilingual educators, and special educators. Students assessed with State approved measures are identified if they meet State criteria, which is a score at or above the 97th percentile, and students with diversity factors receive additional consideration, which includes information from the teacher checklist and the Raven scores. Students assessed with DISCOVER are identified based on their DISCOVER ratings if they meet established criteria, and considered in the same way as others (diversity factors and teacher checklists) if they have high scores but do not meet established criteria.

Identified students are offered placement in existing programs that fit with their profiles and backgrounds. Services in the district include self-contained classes in 5 elementary schools: 2 schools in affluent, mostly Caucasian areas of the city; 1 bilingual school (Spanish and English); and 2 schools in less affluent, mixed ethnicity areas of the city. Itinerant teachers provide services at all elementary schools. The identified students can proceed through the program and continue in "self-contained" programs in two middle schools. In these schools, students attend special classes for the gifted in language arts, math, social studies, and science. One school is in an affluent area of the city, and another in a mixed income and ethnicity neighborhood. At the high school level, a special school is available for those who wish an academically accelerated program, and a variety of programs are offered at other secondary schools.

A Large Suburban School District in the Southwest (in a Different State)

In this district, situated in a suburban area outside a large city, certain high-minority, low-income schools have been targeted as sites for using the DISCOVER Assessment. A team of specialists work with teachers who have cluster groups of gifted students in regular classrooms. These specialists in education of the gifted help teachers (a) provide a curriculum addressing state standards and (b) use teaching approaches in which they integrate several models recommended for teaching gifted students that fit the DISCOVER curriculum framework.

DISCOVER is used to identify talent in 5 highly impacted elementary schools. DISCOVER is administered in the early fall to pre-selected grade levels. The data are then shared with classroom teachers, providing results and profiles for all students in their classes. The data provide insight into students' strengths that would not be found through traditional cognitive testing. Students scoring two ratings of "Definite" in any of the five assessments are placed on a Talent Development Plan. This plan is a guide for classroom teachers providing strength-based goals and accommodations for each of the five areas assessed with DISCOVER. Cluster teachers (one per grade level) are provided additional professional development in spatial artistic, spatial analytical, math, oral linguistic, and written linguistic ability areas so they can better implement strategies for talent development in their classrooms. DISCOVER provides the basis for some instructional decisions such as more opportunities for spatial artistic or oral linguistic products. Cluster teachers serving the talent pool students are provided a notebook with materials that support DISCOVER identified strength areas as well as thinking skills, creativity, questioning, cultural responsiveness, and multiple intelligences. These components form

the basis for a curriculum framework called the GATEway Framework to Achievement. Cluster teachers use this framework to write literacy lessons that develop one or more pieces of the framework. These lessons are included in another section of the materials notebook referenced above. Professional development is provided to all teachers in the targeted schools to increase awareness of strengths identified through the DISCOVER assessment, and how to use those strengths to impact literacy.

Two additional schools will begin to use the DISCOVER Assessment and participate in talent development during the next school year. Expansion continues as interest grows.

A State

A state in the Southwest with a mix of primarily Hispanic, Caucasian, and Native American students has made changes in its policies to permit DISCOVER and Frasier's (Frasier et al., 1995) observation procedures to be used as alternatives to an individualized IQ test as methods for identifying gifted students. If the Frasier method is used, districts also must hold a placement team meeting to consider varied information about the children before placing them in a program. If DISCOVER is used, this meeting is not required.

To assist with statewide implementation of the assessment, several cooperative programs have been initiated with the University of Arizona. Regional trainings are organized, and districts wishing to implement DISCOVER can send a team of new people to receive training or can supplement existing teams by sending one or more individuals. The cost of maintaining assessment teams is minimized since travel expenses for DISCOVER staff members are not necessary, and the districts can have a small number of people involved rather than the larger numbers that might justify a bigger expense. In addition, two individuals who have coordinated DISCOVER Assessments in their school district for many years are certified as State-wide assessment trainers. These individuals provide assessment training and "trainers training" for expert observers from other school districts so that costs are minimized, yet the integrity of the assessment is maintained.

In this state, some small rural districts formed special education cooperatives. They developed a team of observers to assess throughout the cooperative. Some school districts began this way, and later developed their own teams. Some now have their own trainers as well. Larger school districts that initially sent teams to regional trainings have decided to expand their use of DISCOVER to other grade levels, and have certified observers at elementary, middle, and high schools. School districts all over the state are using the assessment, including those with high percentages of both Hispanic and Native American (mostly Navajo) students.

An interesting evolution of the composition of assessment teams in many of these sites is to develop assessment teams consisting of teachers who have retired and live in

the local area. These individuals have a wealth of experience in the local community, but do not know the specific children being assessed. They often have flexible schedules, and they really enjoy having an opportunity to remain involved in education. Pulling teachers out of their classrooms to conduct assessments or to do many other things has become a problem in many school sites, so this is a helpful alternative. Another advantage in certain school districts is that sometimes a requirement of a teacher's retirement is that he or she provides a certain number of days of service in the schools of the district. Involving these teachers in the capacity of observers also reduces the cost of the assessment. Other school districts have supplemented their teams of retired teachers with members of the community, and this can increase the pool of bilingual/bicultural observers available. Individuals from the community receive the same training and certification as employees of the school district, and are updated with the same frequency.

Because of a concern that teacher teams might identify percentages of gifted students that would not be consistent with the percentages identified by individual intelligence tests, policy-makers in this state recommend identifying only students with ratings of "definitely" on three out of the five assessment activities. This standard usually results in the identification of approximately 5% of students, and still includes percentages of Hispanic and Native American students similar to the percentages in the communities in which they live. If placement teams consider other factors, children with "probably" ratings can be placed in a special program.

Since many school districts have not initiated procedures for finding and serving children from culturally, linguistically, and economically diverse groups despite the changes in state policies, they are now being asked to choose either the Frasier observation method or DISCOVER as a way to identify children from underrepresented groups. Directors of special education and coordinators of programs for gifted students receive information and are given opportunities to observe assessments in districts in which the two alternatives are used. All school districts are required to maintain careful records of the numbers of students assessed by all methods they use, and to disaggregate these numbers and percentages by ethnicity. Such record-keeping will provide long-term data about the effectiveness of each method in increasing the numbers and percentages of students from underrepresented groups, and will contribute to effective decision-making on the part of policy-makers.

Three Diverse Countries: Action Research and Integration of Models

In three countries, an exciting cooperative action research project is underway. Together with educators from two very different countries, one in Europe and one in Asia, I have developed a theoretical framework and practical applications in which our research and development experiences are integrated. One book has been published and one is in progress as well as several action research projects in which we are designing, implementing, evaluating, and revising our model and applications. Materials in Appendices D and E come from this project. Similar action research projects in this country will be initiated, and new ones are welcomed.

The new framework represents an integration of DISCOVER with the Thinking Actively in a Social Context (TASC) model originally developed in response to concerns about underachievement, dropout rates, and the standard instructional practice of rote memorization in KwaZulu/Natal schools in South Africa (Adams & Wallace, 1991; Wallace & Adams, 1993), and subsequently applied with aboriginal children in Australia and with children in England; and the Exploring Centers model developed originally for use in a private school in Thailand, and subsequently adopted by public and private schools all over Thailand, including alternative schools and programs operated by the Thai Red Cross (Anuruthwong, 2002). The Exploring Center's use has spread to other Asian countries as well. The description below is adapted and updated from Maker and Anuruthwong (2003) and Wallace et al. (2004).

The Prism of Learning Model

Prism (priz'em) n. a crystalline solid with at least three similar faces paralleling a single axis, for producing or analyzing a continuous spectrum.

A prism is the metaphor we use for this new learning model. The mind of a child is like the beautiful light coming out of a prism—an iridescent rainbow with a spectrum of colors. Each mind is unique, with its own combination of colors, shades, and shapes.

The prism of learning has three sides. On one side is the environment, another the competencies or outcomes we expect from learners; and on the third side are the learning processes. In the middle, or the axis, are human abilities. Often, the three dimensions are not in harmony, and seldom do we synchronize these dimensions with the inner, natural abilities of children. Our responsibility as guides in the learning process is to create more harmony in all dimensions so that the full spectrum of abilities can be integrated and separated in the same way that a prism refracts the light. We must provide the kind of environment that will enable each child to be illuminated from within. Educators can be the most important "illuminators," especially for children without advantages in their home environments.

Problem Solving: The Key Construct in Intelligence and Creativity

At the heart of all theories of intelligence and creativity is the concept of problem solving. Various theories exist to explain the abilities needed to resolve everyday problems as well as to create new knowledge. We use a simple definition: A problem is "a question or situation that presents doubt, perplexity, or difficulty; a question offered for consideration, discussion, or solution" (Webster's II: New Riverside University Dictionary, p. 937). A problem is not necessarily bad. It is a *challenge*: something we want to resolve, change, or create. Problem solving, then, is the process of answering questions, resolving difficulties, creating solutions, and investigating perplexing situations.

To solve problems, people must use five general capacities—memory, creativity, logic, intuition, and metacognition—and ten types of human abilities: social, emotional,

somatic, visual/spatial, auditory, mathematical/symbolic, linguistic, mechanical/technical, scientific, and spiritual. Each of these capacities and abilities are defined in the following sections. To solve problems, people also must use certain learning processes and acquire certain competencies. Integration of capacities, abilities, processes, and competencies in an exciting learning environment is the essence of the prism model.

General Capacities

Memory. Remembering information and experiences is the most basic of the general capacities. To recall a previous experience or data received at an earlier point, people must not only encode it in some way, but must be able to access or recall that information or experience. People must be able to bring data out of storage so they can use it in a meaningful, relevant way in a present situation.

Creativity. Creativity is a general capacity necessary to the functioning of all the dimensions of human abilities. Creativity is the ability to think of, develop, or implement unique and appropriate ideas or solutions. Creativity can result from the association or connection of previously unconnected ideas or things. Ideas or solutions that are creative can be new to the world such as when a scientist develops a revolutionary new theory or can be new to the individual such as when someone creates a new recipe for cooking!

Reasoning/Logic. Reasoning or logic is the general capacity to think in systematic ways, and is a necessary element in all human abilities. The logic necessary to solve a problem in one area may be very different from the logic necessary to solve a problem in a different area. For instance, a humanitarian problem cannot be resolved simply by using numbers and symbols, nor can it be solved through application of formal principles of physics. However, logic has a clearly defined set of principles that can be explained or demonstrated in some way so that others see a chain or connection in the reasoning process. Logical reasoning is a necessary part of evaluating ideas before selecting one as the solution to a problem, and is the key element in "critical" thinking.

Metacognition. Metacognition is self-awareness and the ability to monitor one's own thinking. It is the general capacity to reflect on one's own problem solving processes, identify his logic (or lack of it!), see his flaws, recognize his intuitive insights, and think about his thinking. Metacognitive ability also includes the ability to decide which of one's abilities to use at a particular time—when to be creative or when to be critical, for instance.

Intuition. Intuition often is thought of as the opposite of logic or reasoning, and can be described as the act of knowing without the use of identifiable processes. However, intuitive insights are not illogical! In fact, they may be highly logical. However, the individual may not immediately know the steps necessary to demonstrate the logic of her ideas. Intuition is the ability to know something immediately—without going through steps or sequences of thought. Intuition is the language of understanding, and can be considered our real *first language* while the words, symbols, and sounds an individual learns are part of her *second language*. Gifted people often can't make others

understand what they mean because they have a hard time "conforming" their first language into their second language. Their ideas are so complex they often do not have the words or the structure to explain knowledge they have gained through their first language. Others have a hard time understanding gifted children because they don't have the structure to see or comprehend the gifted person's ideas. For a child who is learning a new language or one who is not proficient in the language of the teacher, the process of putting an intuitive insight into words is even more difficult than for children who are proficient in the language of instruction.

Sensitivity. Sensitivity is emotional and sensory openness to experiences. It is the capacity to respond to experiences and feelings, and to respond with emotional awareness and intensity. Receiving information through the five senses and intuition, and responding to this information with feeling is a key human capacity that is important in learning, creating, performing, and interacting with others. Many children "close down" because of early traumatic experiences or because they constantly are told to hold back their feelings to "be brave" or "be mature," and unfortunately their later learning is compromised because they are not encouraged to be sensitive while developing the emotional or physical competence to manage these sensitivities.

Human Abilities

At the most specific level, humans have ten different of abilities: social, emotional, somatic (touch, movement, taste), visual/spatial, auditory, mathematical/symbolic, linguistic, mechanical/technical, scientific, and spiritual. People have a spectrum of abilities—a broad range of related qualities that are combined in many different ways to solve problems, meet challenges, and create new products. In all activities and careers several of these basic abilities are needed. However, most activities and careers have two or three that are dominant, and therefore essential to success.

Social abilities are skills we need to get along with other people.

Emotional abilities are the skills we need to manage our emotions.

Mathematical/Symbolic abilities consist of the use of abstract models, numbers, mathematical figures and objects that symbolize abstract ideas.

Somatic abilities include large muscle movement as well as small muscle movements, and also include touch, taste, and smell.

Visual/Spatial abilities include seeing things accurately and clearly through one's physical eyes as well as seeing images clearly in one's mind.

Auditory abilities are skills in hearing, producing, and manipulating sounds.

Linguistic abilities are skills in using words.

Mechanical/Technical abilities are the skills needed to understand, create, and repair machines or other devices that perform or help perform human tasks.

Scientific abilities include observing, identifying, describing, classifying, studying, and explaining natural phenomena.

Spiritual abilities include knowledge, ability, and willingness to see beyond bodies and objects to develop awareness and understanding of phenomena related to the human soul or spirit.

Learning Processes

Learning processes can be explained by using the metaphor of a tree. Some learning processes include observing, feeling, connecting, decoding, remembering, imagining, composing, duplicating, symbolizing, translating, developing, crystallizing, transforming, playing, listening, searching, reflecting, sensing, enjoying, producing, exploring, engaging, and inventing. Some learning processes are conscious and some are subconscious, corresponding to the roots (subconscious) and branches (conscious) of the tree. Some processes are above the surface while others are below the surface, and all are essential to the growth and development of the tree.

Learning processes also include the problem solving processes used to meet the challenges of life! As people meet important challenges, they go through a series of steps—either consciously or unconsciously—that result in selecting or implementing a particular solution. Many develop effective methods, while others struggle, use trial and error ineffectively, or select the first idea that comes to mind rather than considering the consequences of several solutions. We believe that both children and adults can benefit from learning a flexible problem solving process they can apply in many and varied situations. Thinking Actively in a Social Context (TASC), the process we advocate, is a "wheel" with eight spokes: gather/organize, identify, generate, decide, implement, evaluate, communicate, and learn from experience. Usually, the process begins with gathering and organizing, and proceeds around the wheel. However, generating ideas may sometimes be the first step, and one may need to re-visit certain steps in a spiral fashion. TASC includes all the learning processes and helps both teachers and children structure their problem solving experiences, becoming more effective problem solvers.

Competencies

Competencies are the things we want children to learn as a result of school or life experiences. Often, educators attempt to categorize or compartmentalize competencies, separating academic subjects in artificial ways. Knowledge is connected and interdependent just as our bodies and all natural systems are connected and interdependent.

We define key ideas for each age and grade level and recommend ways to integrate important information and competencies from the traditional academic disciplines into each of these themes. For example, individuality, change, patterns, relationships, cycles, and environment are key ideas for young children in preschool and early grades (Grades K-2), while conflict, communication, cooperation, interaction, and structures are important ideas to internalize during the middle elementary years (Grades 3-5). Middle school students (Grades 6-8) need to understand concepts such as culture, extinction, exploration, diversity, and systems. Secondary students (Grades 9-12) need to struggle with ethics, beauty, harmony, invention, and interdependence. Secondary school students also must revisit all the other themes with an emphasis on development of competencies needed for life success.

Learning Environment

The environment influences growth, but does not dictate how the growth will occur. If, for instance, a tree does not have enough water, it will not grow as much as it will with plenty of water. On the other hand, if a tree has too much water, it also may die. However, trees are capable of making adaptations to changing conditions. For example, in the fall and winter, deciduous trees shed their leaves and become dormant to survive lower temperatures. When these deciduous trees do not get enough water, they often will shed their leaves, enabling their precious water supply to be used by the main trunk—the part necessary for survival. The same is true with people. If the environment is too "strong" (structured or over-planned, chaotic—corresponding to too much or too little water), the environment will dominate the adaptation. However, if the environment is "neutral" (natural, enabling, regular, open—corresponding to regular rain and drought cycles), a person will grow normally and make her own adaptations. Remember, though, that humans have a wider range of adaptive capabilities than trees, and may also be more sensitive to environmental conditions.

The learning environment has two major components: *physical* and *dynamic*. The physical environment includes color, shape, temperature, light, sound, textures, and materials. The physical environment includes buildings, playgrounds, trees and other natural things as well as the way the teacher sets up the classroom, organizes the chairs, puts posters on the walls, and organizes input or stimuli. The dynamic environment includes the teaching methods and processes as well as the ways teachers interact with children. The activities the teacher organizes, the questions she asks, the reinforcement or punishment methods, and the classroom management techniques are part of the dynamic environment.

How to Make Effective, Joyous Learning Happen

We believe that the best way to make effective, joyous learning happen is to set up a learning center (as big a room as possible) with a "corner" or special place for each of the human abilities except social and spiritual. Put in a creative, empathic, knowledgeable teacher/guide, include both individual and group activities that are challenging and engaging; bring in the children, and let them explore and discover! The teacher designs a learning environment to facilitate learning, maintains this environment, and develops ways to motivate and challenge students while allowing sufficient time for exploration and discovery. In this environment, learning is fun for both the teacher and the children!

A center can be in an individual teacher's classroom or can be a large room in a school, serving all children in the school. We can identify advantages and disadvantages to both these models, so educators can choose the model that works best within their budgets or school space limitations. In the description that follows, when we are talking about a learning center in an individual classroom, we call it a learning center and if the learning center is in the school, we will call it an Exploring Center since this idea was

developed in depth by Usanee in Thailand. The areas in which children discover and explore are called "corners."

Belle, June, and Usanee are working on manuals and examples to provide guidance to everyone who wants to make learning effective and joyous by using the prism of learning model. Here is a general description of learning and Exploring Centers.

Overview of the General Plan

In each corner, put materials that children can use independently, materials that are flexible and have much potential to excite curious minds—materials that can be used to challenge children at many different levels of ability. The materials must be well-chosen and durable. The learning spaces for each "corner" need to be large enough to accommodate 5 or 6 students at a time without being crowded. Children need places to work and talk with others as well as places to work alone.

In the center of the room, put general tools such as computers, video equipment, audio recorders/players, and printers. In this area, also include a space where students can gather to have group activities and talk about projects. A round space is preferred since it will facilitate student interaction. Around the periphery of this round space, put containers that can hold individual cards with activities for children to do. These cards are re-usable and color-coded, and they contain suggestions for problem solving activities to be done either alone, with a partner, or with a group of students.

Problem solving activities on the cards are related to both the competencies and the human abilities in the prism model. Children solve problems that are well-defined as well as problems that are "fuzzy and ill-defined." The challenges included in the cards are designed to develop the children's general capacities of creativity, intuition, reasoning, and metacognition as well as their competencies (e.g., individuality, change, relationships, conflict, structures, exploration, systems, ethics, harmony) and their learning processes (e.g., observing, feeling, connecting, composing, transposing, remembering, sensing, inventing, problem solving). In other words, activity cards are designed to integrate the outer surface elements of the prism of learning with the inner axis of the prism—the spectrum of human abilities.

If the center is in a school, children from each classroom come to the Exploring Center with their class and their teacher. Usually, a group activity is planned at the beginning. When the children first begin to use the Exploring Center, more time is spent on this activity. Children learn the parts of the TASC problem solving model and ways to use it in solving the open-ended problems presented in the centers as well as in student-designed investigations. Activities planned for the whole group usually involve social or spiritual abilities, but also can be designed for other purposes: to help children learn some concept, to exercise a particular learning process, to introduce children to new materials or to materials they have not been using, or to serve another important purpose identified by the teacher(s). Group activities are limited to 10 or 15 minutes except in special instances. Most of the children's time in a school Exploring Center needs to be

spent on self-selected activities. Children need to be free to explore and discover in all the centers, and to spend an extended time in the problem solving activities that are of most interest to them. So, after the group activity, students may choose a corner. They go to a central place and take a marker or a card with the name of the corner where they will spend their time.

Near the end of the time students are in the Exploring Center, bring them all together. Students then record what they did during their time. If they have pictures of products they developed, they put these in a portfolio and write or draw about their experiences. The teacher also may ask students to reflect on certain aspects of their participation or performance.

If the learning center is in a classroom, the teacher will need to decide how much time students can spend on independent activities, and how much time they will spend on group activities. The teacher also can design group activities in which students can choose materials from or choose to work in the different corners, depending on the children's interests and strengths. Some teachers may need to begin by allowing the children to work in the corners for a few hours each week, and gradually increase the time in corners as children become more independent and the teacher sees the value of this independent exploration. We recommend approximately 2 hours each day as an optimum amount of independent exploration. Regardless of the overall amount of time teachers feel comfortable allowing, students need to have enough time to complete complex projects rather than rotating through corners or being allowed only a few minutes to work independently. Children who have completed their practice or other assigned work can be allowed to work in corners at any time, thus minimizing their boredom or disruption in the classroom.

Assessment and Evaluation

Learning about the strengths and abilities of the children is important for effective, joyful learning. The assessment serves several purposes: to find out how to guide or assist children while they are in the classroom or center, to help children and their parents choose and organize learning experiences to develop the children's natural abilities, and to help everyone teach each child more effectively.

The classroom teacher, teaching assistants, and the teachers in the Exploring Center use specially-designed checklists to observe each child as he or she participates in the corners. These checklists include problem solving behaviors and characteristics of the things children produce. Observation must happen over a long period of time, be done with reliable and valid instruments, with a wide "lens," and with multiple procedures and observers. Teachers use a system of rotation in which they make a special effort to observe a certain number of children each day. The number observed each day is determined by the number of students they see, and must allow them to observe each child at least 2 times each term. Teachers also will note special performances or products made by anyone, regardless of whether the child was one of the students to be observed that day.

A second aspect of assessment is a special assessment day. For 1-2 weeks each year, all students who use the Exploring Center participate in specially-designed assessment activities. If all or many teachers in a school create a learning center in their classrooms, a week can be spent in a cooperative program in which teachers lead students through certain activities and observe their problem solving in each of the human abilities (See Appendices C and D for examples of these activities. A complete description of "assessment weeks" held in three schools can be found in Wallace et al., 2004.) One interesting, engaging activity is set up in each corner. An adult who is interested in that corner or has high abilities in it—and who has practiced observing the activity—is stationed in the corner to observe children as they participate in the activity. Observers watch, take notes, and take photographs of the children's products. Observers collect and photograph products such as artwork, written and oral stories, and other creations. Children rotate through the corners. After all children of a particular group or grade level have been assessed, the observers complete checklists of abilities and assign ratings to show each child's pattern of abilities. (See Appendix E for the current version of these checklists.)

A third aspect of assessment is examination of students' portfolios. Portfolios include their drawings, records of which corners they visited and the activities in which they participated, and their reflections. Also included in a complete assessment is student self-assessment in each of the areas of human ability. At least once each term, students need to be asked to complete a self-evaluation.

Finally, teachers who conducted the assessment for the school or teachers in the Exploring Center compile the assessment information from all sources and have a conference to decide what they believe to be the most important abilities of each child. They also identify areas of challenge that may interfere with development or expression of the child's abilities. If additional assistance or another perspective is needed, teachers may invite an expert in the particular human abilities being examined or another person familiar with the child to join the conference. Teachers compile all information using the checklists and report forms, and schedule a conference with parents and other teachers to discuss what they have learned about each child.

If a learning center is set up in individual classrooms, a specialist also can work with all teachers to implement all aspects of the prism model, including the assessments, in their individual classrooms. This way of implementing the new model is described in detail, with many practical examples, in Wallace et al., (2004).

Summary: Where Do We Go From Here?

Across these diverse settings, and resulting from the research presented in the two sections preceding this one ("Introduction" and "Setting the Stage"), general principles and recommendations emerge that can provide a useful guide to educators wishing to increase the participation of and improve services to students from underrepresented groups in programs for the gifted. In the "Concluding" section that immediately follows,

I present and explain recommendations for important groups: policy-makers, principals, coordinators of special education and programs for gifted students, and teachers.

PART 4: Conclusion—Next Steps, Recommendations, and Resources

Policy-makers

- Develop criteria for schools and school districts to use in selecting instruments to identify gifted students. Require evidence for the validity of the interpretations and uses of the test: (a) demonstrated effectiveness in identifying gifted students from varied cultures, students whose first language is not English, students with disabilities, and students from low income families; (b) acceptable predictive validity for the purpose of identifying gifted students from underrepresented groups; (c) acceptable reliability for the purpose of identifying gifted students from underrepresented groups; and (d) construct validity for the purpose of identifying gifted students from underrepresented groups.

- Change existing policies to include the use of alternative, performance-based, research-based, theory-driven assessments such as DISCOVER that have been successful in increasing the percentage of identified gifted students from culturally, linguistically, and economically diverse groups and those from geographically isolated areas.

- Evaluate all instruments currently being used to identify gifted students using the criteria in the Barriers and Facilitators tables included in the "Introduction" Section. Report these evaluations to those who will be making decisions about testing.

- Develop policies and procedures requiring schools and school districts to maintain careful records of the numbers and percentages of students identified as gifted from different cultural groups, linguistic backgrounds, economic levels, and geographical regions using different instruments. Maintain this information in a database for use in tracking the usefulness of various instruments.

- Implement pilot programs in which the progress (success in the program or in regular classrooms) of students identified by the various instruments in use is monitored. Analyze these data and report the results to others using or considering these instruments.

- Change existing policies to include requirements for identifying multiple forms of giftedness.

- Disseminate information about effective instruments, acceptable procedures, appropriate curricula, and effective instruction for gifted students from underrepresented groups.

- Change existing or create new policies to require that all students be served in ways that are consistent with their strengths and challenges identified during assessments.

- Evaluate services, curricula, and instruction based on the barriers and facilitators for curriculum and instruction included in the "Introduction" section of this monograph. Report these evaluations to those who will be making decisions about services, curricula, and instruction in programs for gifted students.

- Provide funding for long-term research and evaluation of alternative methods for identification of students from underrepresented groups. Development of these methods is not enough. They must be evaluated and their success monitored on a long-term basis.

- Develop, implement, and monitor compliance with regulations requiring schools and school districts to serve appropriate numbers of students from culturally, linguistically, and economically diverse students and students with disabilities in programs for gifted students. The Office of Civil Rights' monitoring needs to be supported and supplemented by complementary efforts at the State and local levels.

- Ensure that parents and community members of color are represented on all advisory committees.

Program Coordinators for Special Education, Bilingual Education, and Education of Gifted Students

- Pilot the DISCOVER assessment in one or a few schools in which very few gifted children have been identified to test its usefulness in your district. Maintain the results for several years, and track the progress (success) of the students who are placed in programs as well as those identified and not placed. Analyze these results to make further decisions about expansion or continuation. Provide information about the strengths and levels of ability of all children assessed so teachers can develop positive perceptions and provide instruction addressing these strengths, especially those children who were on the borderline (e.g., rated "definitely" or "probably" in more than one area, but not in enough areas to be considered gifted by the district or State definition).

- Create partnerships between bilingual education and education of the gifted so that efforts to identify and serve children are coordinated and resources are combined.

- Include many types of screening and referral procedures to supplement teacher referral as a first step in deciding which children to test or examine further. Include some performance-based measures such as the DISCOVER open-ended writing exercise or the math worksheet. These can be used in schools that are not using the full assessment.

- If portfolios are used as a part of the referral, screening, or identification process, have some work samples requiring problem solving, higher-order, and/or creative thinking collected in a consistent way across all teachers. This can be accomplished by a specialist or itinerant teacher of the gifted.

- Interview teachers about the characteristics of the students in their classrooms instead of sending or handing them a written checklist. An interview process and protocol we have piloted in schools with diverse populations is included in Appendix C.

- If you decide to continue to use teacher checklists, select these checklists based on research with children from diverse backgrounds to use in schools and classrooms containing children from diverse backgrounds.

- Evaluate tests and make decisions about which to choose based on the barriers and facilitators included in the "Introduction" section of this monograph.

- Change your vocabulary and the vocabulary of others—from talking about "the gifted" to talking about "students/children who are gifted in _____"(e.g., language, math, dance, visual arts, leadership, emotional competence, or other categories you and your school district believe are important).

- Disseminate information about ways to observe students in the classroom to gain information about their strengths in varied areas. The activities and checklists in Appendices D and E have been tested by many teachers, and are useful in early elementary classrooms, including special education classes.

- Develop services for gifted students instead of "a program."

- Choose or create services for each student based on a careful consideration of both strengths and challenges.

- Provide a wide range of services, including many options for parents and children to choose based on needs and cultural values.

- Evaluate services, curricula, and instruction based on the barriers and facilitators for curriculum and instruction included in the "Introduction" section of this monograph.

Principals

- Examine your own beliefs to decide if your views are more consistent with the traditional or emerging paradigm related to giftedness (presented in the "Introduction" section of this monograph).

- Interview or find other ways to elicit teacher statements or information to help you find out the perspectives of the teachers in your school. Determine whether their views are consistent with the traditional or emerging paradigm and how they match with your views. Initiate discussions and study groups to examine these consistencies or discrepancies, and devise ways to resolve discrepancies.

- If it fits with your perspectives and the perspectives of many of your teachers, or if you are willing to try a different approach, present the DISCOVER Assessment and Curriculum Models to teachers for possible implementation in your school. Involve the teachers or a selected group of influential teachers in examining it and deciding whether to implement it school-wide.

- Evaluate practices in the school to determine their consistency with your perspectives and the teachers' perspectives on giftedness. Devise ways to change practices so they are aligned more closely with beliefs, or devise ways to change beliefs so they are aligned more closely with appropriate practices.

- Provide support and incentives for teachers who design curricula and provide learning experiences that are consistent with the emerging paradigm (presented in the "Introduction" section of this monograph).

- Disseminate information about the DISCOVER Curriculum model, encouraging its use in individual classrooms whether or not it is used school-wide. Provide the teaching units in Appendices F, G, and H to teachers who may be interested in trying them.

Teachers

- Examine your own beliefs about giftedness, and think about how they evolved. Compare them with the traditional and emerging paradigms of giftedness presented in the "Introduction" section of this monograph.

Carefully consider your teaching practices. Are your practices consistent with what you think you believe? Why or Why not? What can you change today or tomorrow that will increase the alignment of your viewpoints and practices? Think about it, and start right away!

- Implement the DISCOVER Curriculum Model in your classroom if it is consistent with your perspectives on giftedness, and you are ready to try something different. The teaching units in Appendices F, G, and H have many ideas that can get you started.

- If you think DISCOVER might work in your school or district, present information about it to decision-makers.

- Whether or not you choose to use the DISCOVER curriculum model, implement changes that can increase your ability to teach children with diverse gifts, talents, cultural backgrounds, languages, and economic levels effectively in your classroom or program:
  - View all your Students as being "At Promise"
  - Assess the Strengths and Interests of all the students
    - ≈ DISCOVER Assessment
    - ≈ Interviews with children and parents
    - ≈ Observation, especially during open-ended problem solving activities (See the activities and checklists in Appendices D and E, which have been used by many teachers.)
  - Expand Students' Experiences (Across Types of Problems and Areas of Intelligence)
    - ≈ "Invitations" to try something different
    - ≈ Requirements for different areas and types of problems
    - ≈ Exciting activities and people
  - Provide Students Opportunities to
    - ≈ Develop strengths to a higher degree
    - ≈ Develop interests
    - ≈ Develop weaknesses to a higher degree
    - ≈ Combine strengths with weaknesses for the benefit of both
  - Involve Students in Decision-Making Through
    - ≈ Developing criteria for their products, especially the results of open-ended problem solving
    - ≈ Choosing areas of intelligence, types of problems, and long-term projects
    - ≈ Designing their learning environment or the environment of the classroom
  - View Parents and Caretakers as Partners
    - ≈ Make visits to children's homes and communities
    - ≈ Ask parents and caretakers about their perceptions of their child's needs and their goals for their child

- ≈ Call to tell parents and caretakers about successes and the good things their child has done
- Expand the Assessments Used to Measure Success in Ways that Are "Intelligence-Fair"
  - ≈ Creativity
  - ≈ Problem solving and higher-order thinking
  - ≈ Portfolios and work samples
  - ≈ Performances
  - ≈ Interviews
- Move Into These Changes at Your Own Pace and Have Fun!
  - ≈ Enlist the help of others (including parents, students, colleagues, community members, your family)
  - ≈ Explain what you are doing to the principal and/or coordinator of the program for the gifted, and ask for their support.

Resources

In the appendices to this report, many materials are provided: an annotated bibliography of publications about DISCOVER (Appendix A), correlations between DISCOVER activities at different grade levels (Appendix B), an interview format to use with teachers instead of written forms for rating student characteristics and making referrals (Appendix C), suggested activities and characteristics for observing and identifying children's problem solving in different ability areas (Appendix D), checklists of observable general problem solving characteristics to use with activities such as those in Appendix D (Appendix E), and three teaching units based on the DISCOVER Curriculum principles (Appendices F, G, and H). Another resource is the DISCOVER web page at www.discover.arizona.edu and you can use information from the web to contact the DISCOVER team of professionals to gather more information or request other resources listed on the web site.

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Appendix A:
Annotated Bibliography of Publications About DISCOVER

Annotated Bibliography of Publications About DISCOVER

Griffiths, S. (1997). *The comparative validity of assessments based on different theories for the purpose of identifying gifted ethnic minority students.* Unpublished doctoral dissertation, The University of Arizona, Tucson.

Profiles of 33 Mexican American kindergarten students assessed using DISCOVER, WISC-III or WPPSI, and Raven Progressive Matrices were analyzed to gather information on the relationships among sub-parts of the assessments. The author found that each of the three assessments fit the theory on which it was based, that they measured different abilities, and that the DISCOVER assessment seemed to be a more valid measure for the purpose of identifying Mexican-American students as gifted.

Maker, C. J. (1992). Intelligence and creativity in multiple intelligences: Identification and development. *Educating able learners: Discovering and nurturing talent, 17*(4), 12-19.

In this article, the activities initially designed to assess problem solving in multiple intelligences in young children (grades K-2) are described. Also included are some of the behaviors observed in children who seem to be effective problem solvers. The activities have been revised and modified since publication of this article based on research on their use.

Maker, C. J. (1993). Creativity, intelligence, and problem-solving: A definition and design for cross-cultural research and measurement related to giftedness. *Gifted Education International, 9,* 68-77.

This article contains an explanation of the theory underlying the DISCOVER projects: the relationship between creativity, intelligence, problem solving, and the multiple intelligences theory of Howard Gardner. It also contains a description of the research design used to structure a series of studies testing the theory and a summary of the most important results of these studies.

Maker, C. J. (1994). Authentic assessment of problem solving and giftedness in secondary school students. *The Journal of Secondary Gifted Education, 6*(1), 19-26.

Beginning with a discussion of authentic assessment and problem solving, the author then describes how others can develop authentic assessments of problem-solving in secondary school students. The DISCOVER assessment process (both its development and its current form) is described, along with suggestions for validation procedures.

Maker, C. J., Nielson, A. B., & Rogers, J. A. (1994). Giftedness, diversity, and problem-solving: Multiple intelligences and diversity in educational settings. *Teaching Exceptional Children, 27*(1), 4-19.

Written for practitioners, especially teachers, this article provides an overview of the philosophy and implementation of the DISCOVER assessment, curriculum, and teaching approach. With specific examples of student responses, teaching activities, and photographs of children to supplement the text, it provides an introduction to all phases of the project. Teachers, parents, and administrators who have implemented the DISCOVER approach write about their experiences from their own perspectives, and these are included along with the general text written by the developers of DISCOVER.

Maker, C. J. (1995). Lessons learned from the children. *Understanding Our Gifted, 8*(1), 1, 8-13.

The author describes four students from diverse cultural, linguistic, and economic backgrounds and the strengths of each that she has observed. She concludes each description by identifying the important the lessons she has learned through her interactions with each child.

Maker, C. J. (1996). Identification of gifted minority students: A national problem, needed changes and a promising solution. *Gifted Child Quarterly, 40,* 41-50.

The serious national problem of under-representation of culturally diverse groups in programs for gifted students is addressed. Old and new paradigms, including changing conceptions of giftedness based on a new paradigm, are described. A new assessment process, consistent with the new paradigm, is presented, along with suggestions for validating and refining this assessment in ways that are consistent with its underlying thought system (paradigm).

Nielson, A. B. (1994). Traditional identification: Elitist, racist, sexist? New evidence. *CAG Communicator: The Journal of the California Association for the Gifted, 24*(3), 18-19, 26-31.

The linguistic, cultural, and economic biases inherent in Lewis Terman's often quoted studies of giftedness are explained in this article, and their effects on IQ testing of diverse populations are outlined. Characteristics of families of children identified as gifted using traditional IQ testing are compared with families of children identified using an assessment process (DISCOVER) designed to measure problem solving in multiple intelligences.

Maker, C. J., Rogers, J. A., Nielson, A. B., & Bauerle, P. (1996). Multiple Intelligences, problem solving, and diversity in the general classroom. *Journal for the Education of the Gifted, 19*(4), 437- 460.

This article is a report on a pilot study of the effectiveness of the DISCOVER approach to curriculum design and teaching strategies when used in regular (homogeneous) classrooms with young children from culturally diverse backgrounds. It contains a short description of the DISCOVER assessment, a description of the curriculum and teaching strategies developed to build upon student strengths and interests,

an explanation of the pilot study, and the impact of the teacher classified as a "high implementer" on the students' growth in problem solving in spatial, logical-mathematical and linguistic intelligences.

Maker, C. J., & King, M. A. (1996). *Nurturing giftedness in young children*. Reston, VA: Council for Exceptional Children.

In the first part of this book, the authors describe three real classrooms in which teachers are consistently nurturing the giftedness of young children, especially the six who are described. In the second part, the principles of developmentally appropriate practice are explained and examples of how they apply to the nurturing of children with diverse abilities are provided.

Maker, C. J., & Nielson, A. G. (1996). *Curriculum development and teaching strategies for gifted learners* (2nd ed.). Austin, TX: Pro-Ed.

Using a definition of giftedness based on the Multiple Intelligences theory of Howard Gardner, the authors explain and give many practical examples for designing and implementing curriculum to meet the needs of gifted students in regular classrooms and in special programs. The principles are explained in chapters on learning environment, content, process, and product, and examples of daily planning, unit development, and school or district-wide curriculum sequencing based on the DISCOVER Curriculum Model are provided.

Maker, C. J. (1997). DISCOVER Problem Solving Assessment. *Quest, 8*(1), 3, 5, 7, 9.

After a brief description of the DISCOVER assessment, Maker presents a review of research on its development, reliability, and validity for its two intended purposes: identifying the strengths of all students in a classroom and identifying students who are gifted in a way that is equitable across gender, language, economic, and cultural groups.

Lori, A. A. (1997). Storytelling and personal traits: Investigating the relationship between children's storytelling ability and their interpersonal and intrapersonal traits. *Gifted Education International, 13,* 57- 66.

The relationship between storytelling ability and interpersonal and intrapersonal traits in Bahraini students is reported in this article. The DISCOVER assessment results were analyzed, and problem-solving behaviors were correlated. Significant relationships were found between students' storytelling and their personal traits. Additional statistical analysis revealed that third graders were better storytellers than fourth graders. Based on these results, the author recommended educational practices to enhance students' linguistic and communicative competencies.

Rogers, J. A. (1998). Refocusing the lens: Using observation to assess and identify gifted learners. *Gifted Education International*, *12,* 129-144.

Rogers presents a clear view of how the parts of the DISCOVER assessment are connected to each other and to the underlying theoretical frameworks. She integrates many practical examples showing students' responses, and makes the article come alive. This article is "required reading" for everyone who wants to understand the assessment. Please note, however, that changes have been made in the assessment process since the article was written.

Sarouphim, K. M. (1999). DISCOVER: A promising alternative assessment for the identification of gifted minorities. *Gifted Child Quarterly, 43,* 244-251.

In this review, the author describes the DISCOVER assessment and reviews preliminary studies on its reliability and validity. She concludes that the DISCOVER assessment seems to be a promising alternative technique through which the problem of under representation of gifted minorities in programs for the gifted might be reduced. However, educators using the DISCOVER assessment for identification purposes must make sure that a good match exists between the assessment and the type of gifted program in which students will be placed.

Sarouphim, K. M. (1999). Discovering multiple intelligences through a performance-based assessment: Consistency with independent ratings. *Exceptional Children, 65*(2), 151-161.

The purpose of this study was to investigate the consistency between performance-based DISCOVER assessment results and two independent ratings (teacher, observer) in appraising students' multiple intelligences through specific activities. The three accounts showed similar results strengths and weaknesses in spatial, logical-mathematical, and linguistic intelligences. However, specific tasks should be designed to appraise bodily-kinesthetic, interpersonal, and intrapersonal intelligences to increase the effectiveness and credibility of assessment of students' abilities throughout the whole spectrum of intelligences.

Sarouphim, K. M. (2000). Internal structure of DISCOVER: A performance-based assessment. *Journal for the Education of the Gifted*, *23*(3), 314-327.

A sample of 257 Navajo and Mexican-American students from kindergarten, fourth, and fifth grades were participants in an analysis of the extent to which the DISCOVER behavior checklist and rating process fits the theory on which it is based. The author found low and nonsignificant correlations between ratings on activities assessing different intelligences and moderate relationships between activities designed to measure the same intelligences. She also found no gender biases in the identification of boys and girls as gifted, and concluded that more research on validity is needed.

Sarouphim, K. M. (2001). DISCOVER: Concurrent validity, gender differences, and identification of minority students. *Gifted Child Quarterly, 45,* 130-138.

Using the Raven Progressive Matrices as a comparison measure, Sarouphim examined the concurrent validity of DISCOVER in two cultural groups—Mexican American and Navajo. Her sample consisted of 257 kindergarten, second, fourth, and fifth graders. She found low, non-significant relationships between the Raven scores and the linguistic activities except at the kindergarten level, where they were low but significant. The low correlations with linguistic activities were expected due to the Raven's emphasis on non-verbal abilities. Moderate to high correlations between the Raven scores and the Spatial Artistic, Spatial Analytical, and Logical-Mathematical activities found at all grade levels support the concurrent validity of DISCOVER since these activities are designed to measure abilities similar to those measured by the Raven. The results also show that DISCOVER and the Raven are different measurements since the statistically significant correlations range from .251 to .704, with most in the .2 to .4 range. Sarouphim also found no significant gender differences in the number of boys and girls identified as gifted, and that high percentages of students from these traditionally under identified groups were identified as gifted using DISCOVER.

Maker, C. J. (2001). DISCOVER: Assessing and developing problem solving. *Gifted Education International, 15,* 232-251.

In this article, the author reviews the DISCOVER Assessment and Curriculum models, describing the current versions of both, and including many photographs of children involved in assessment and talent development. Examples of teaching activities are provided, and research on both the Curriculum and Assessment is reviewed. Both published and unpublished studies are included in the review.

Sarouphim, K. M. (2002). DISCOVER in high school: Identifying gifted Hispanic and Native American students. *The Journal of Secondary Gifted Education, 14*, 30-38.

Navajo and Mexican American students from grades 9 through 12 were participants in an analysis of the extent to which the DISCOVER behavior checklist and rating process fits the theory on which it is based. The author found low and non-significant correlations between ratings on activities assessing different intelligences and moderate relationships between activities designed to measure the same intelligences. No statistically significant differences were found in the percentages of students from different cultural groups (Mexican American, Native American, and Caucasian) identified as gifted. The percentages of identified participants were mostly in proportion to their ethnic distribution in the sample. She also found no gender biases in the identification of boys and girls as gifted, and concluded that DISCOVER is a promising method for identifying gifted students from culturally diverse groups.

Sak, U., & Maker, C. J. (2003). The long-term predictive validity of a performance-based assessment used to identify gifted CLD students. *Proceedings of the 15th Biennial World Conference of the World Council for Gifted and Talented Students*. Adelaide, Australia: World Council for Gifted and Talented Students.

Two studies are reported in this paper. In both studies, children were assessed with DISCOVER in kindergarten. Records of the children assessed in 1994 and 1998 who were still in the school district were examined. Their scores on the Arizona Instrument to Measure Standards (AIMS), the Stanford 9 Achievement Test (Nationally normed), and grades in English, Math, and Science were collected. Authors found significant differences between those identified as gifted and those not identified as gifted across both instruments and grades in all subjects. In general, the differences were parallel to the areas in which they were identified. Authors concluded that the results support DISCOVER's use as an instrument to identify gifted students, and that kindergarten results can predict achievement as much as 6 years later.

Sarouphim, K. M. (2004). DISCOVER in middle school: Identifying gifted minority students. *The Journal of Secondary Gifted Education, 10*, 61-69.

Navajo and Mexican-American students from grades 6 through 8 were participants in an analysis of the extent to which the DISCOVER behavior checklist and rating process fits the theory on which it is based. The author found low and non-significant correlations between ratings on activities assessing different intelligences and moderate relationships between activities designed to measure the same intelligences. No statistically significant differences were found in the percentages of students from different cultural groups (Mexican American, Native American, and Caucasian) identified as gifted. The percentages of identified participants were mostly in proportion to their ethnic distribution in the sample. She also found no gender biases in the identification of boys and girls as gifted, and concluded that DISCOVER is a promising method for identifying gifted students from culturally diverse groups.

Wallace, B., Maker, C. J., Cave, D., & Chandler, S. (2004). *Thinking skills and problem-solving: An inclusive approach.* Reading, England: A B Academic Publishers.

In this practical book for teachers, DISCOVER and the Prism of Learning Model developed by Maker, Anuruthwong, and Wallace are combined with Thinking Actively in a Social Context (TASC), a model for developing thinking and problem solving. The book contains a report on action research in two schools using the combined model, and has many practical teaching examples, checklists for observing children, and activities for assessment. The emphasis is on early childhood education.

Chen, A. (2004). *DISCOVER in China.* Beijing: Capital Normal University Press.

The author, a scholar of DISCOVER and a leader in the DISCOVER in China Project, describes the use of the problem solving continuum and the multiple intelligences matrix across content areas in Chinese schools. She reviews literature on problem solving, and discusses the importance of developing creativity and problem solving in Chinese schools. She reflects on the development of teachers' competence in implementing the project, and presents a helpful description of the stages through which

teachers progress as they begin to implement the problem solving continuum. The book is written in Chinese.

Maker, C. J., & Schiever, S. W. (in press). *Teaching models in education of the gifted* (3rd ed.). Austin, TX: Pro-Ed.

The emphasis of this book is on teaching models that have been developed for or can easily be adapted for the teaching of gifted students. Ten different models are described, and a final chapter includes suggestions for combining models to form a comprehensive approach. DISCOVER is one of the models described in the book.

Maker, C. J. (2004). Creativity and multiple intelligences: The DISCOVER project and research. In S. Lau, N. N. Hui, & Y. C. Ng (Eds.), *Creativity: When east meets west* (pp. 341-392). Singapore: World Scientific Publishing.

What is more important, to be creative or to be intelligent? Are creative people also intelligent? Are intelligent people usually creative? What do we want to foster in our children and youth? What is best for our society or nation? How do schools need to be different if we want to develop students' creativity as well as their intelligence and skills? What experiences and research can be helpful in answering these questions? In this chapter, the author argues that intelligence and creativity are not really different, but result from responses to certain prompts in the form of tests or teaching activities, or from adults' attitudes toward a child's responses to tests, questions, or products. She presents evidence from her own and others' research to support her arguments and gives specific ways that researchers, teachers, parents, and other adults in Eastern and Western countries can foster the natural abilities of children and youth—helping them to develop their problem solving and adaptability for the world of the future.

Sak, U., & Maker, C. J. (2004). DISCOVER Assessment and Curriculum Model: The application of theories of multiple intelligences and successful intelligence in the education of gifted students. *Eurasian Journal of Educational Research*, *15*, 1-15.

The authors provide a discussion of the theories underlying the assessment and curriculum model. They also review the evidence for reliability and content, criterion, and construct validity from over 15 years of research. Authors also present evidence for the success of the curriculum model, and discuss the use of DISCOVER in programs for gifted students.

Appendix B:
Correlations Between DISCOVER Activities at Different Grade Levels

Intercorrelations Between Observer Ratings on DISCOVER Assessment Activities at Six Grade

Levels

Activities		Spatial Analytical	Mathematical (Interpersonal)	Oral Linguistic	Written Linguistic
Spatial Artistic	K	.04	.22	.10	.10
	2	.07	.23	.14	.02
	4	.12	.09	.13	.28
	5	.02	.17	.10	.16
	6-8	.23	.26	.07	.01
	9-12	.21	.23	.26	.19
Spatial Analytical	K		.08	.16	.11
	2		.00	.11	.10
	4		.52	.24	.24
	5		.28	.10	.15
	6-8		.10	.08	.08
	9-12		.28	.21	.29
Logical Mathematical (Interpersonal at Grades 9-12)	K			.01	.10
	2			.07	.15
	4			.39	.05
	5			.22	.21
	6-8			.18	.08
	9-12			.29	.23
Oral Linguistic	K				.29
	2				.37
	4				.43
	5				.34
	6-8				.25
	9-12				.56

Note. Data were taken from the following studies:

Sarouphim, K. M. (2000). Internal structure of DISCOVER: A performance-based assessment. *Journal for the Education of the Gifted, 3,* 314-327.

Sarouphim, K. M. (2002). DISCOVER in high school: Identifying gifted Hispanic and Native American students. *The Journal of Secondary Gifted Education, 14*, 30-38.

Sarouphim, K. M. (2004). DISCOVER in middle school: Identifying gifted minority students. *The Journal of Secondary Gifted Education, 10*, 61-69.

Appendix C:
Interview Guide for Reporting Student Characteristics and Making Referrals

STUDENT STRENGTH ASSESSMENT

INTERVIEWER'S GUIDE

By C. June Maker, Ph.D.

Department of Special Education, Rehabilitation, and School Psychology

The University of Arizona

Directions for Interviewers: Using the interview questions for each characteristic, ask each teacher to name children/youth in his/her classes who fit the description.[1]

When the teacher gives a name, ask for some examples of things the student(s) do. Based on their examples, record the letter that corresponds to the area(s) in which the students show their ability.

If the teacher does not give a name or names immediately, or does not think of anyone in certain category, give her/him examples from the list provided. These examples also may be helpful if teachers are having trouble deciding about students or they wish additional information to help think about the strengths of students in their classes.

1. Humor: Which student or students in your class seem to have exceptionally keen sense of the comical, bizarre, or absurd?

Examples

Spatial – (S)
- Draws funny cartoons
- Makes things that are funny or that seem weird or bizarre

Linguistic – (L)
- Invents or plays with words
- Uses concepts or vocabulary from first or second language inappropriately to make people laugh
- Tells funny stories
- Writes weird, funny or bizarre stories
- Adds humor to other assignments such as reports or discussions

Logical-Mathematical – (LM)
- Creates cause-effect relationships that seem funny or bizarre
- Uses numbers or math concepts in humorous ways
- Creates parodies of scientific processes

Personal – (P)
- Shows a sense of humor that delights, entertains, or surprises other people – either age-mates or adults
- Uses stories, jokes or comments that make people laugh to ease tension in a group
- Has ability to satirize political correctness or social conventions

Musical – (M)
- Makes up funny, weird, or bizarre music

[1] Questions are based on the description of characteristics of gifted learners developed by L. S. Kanevsky, C. J. Maker, A. B. Nielson, and J. A. Rogers published in C. J. Maker and A. B. Nielson (1996). *Curriculum development and teaching strategies for gifted learners* (2nd ed.). Austin, TX: Pro-Ed. The original list of characteristics is based on the word of Mary Frasier [Frasier, M .M. and Passow, A. H. (1994). *Toward a new paradigm for identifying talent potential* (Research Monograph 94112). Storrs, CT: The National Research Center for Gifted and Talented, University of Connecticut].

Bodily Kinesthetic – (BK)
- Creates facial expressions and movements that are funny, crazy, or bizarre
- Uses drama, dance, or athletics to make people laugh

2. <u>Motivation</u>: Which student or students in your class have an intense desire to know, do, feel, create, or understand?

Examples

Spatial – (S)
- Wants to draw or make things all the time
- Doodles, scribbles, or draws during class discussions
- Continues working on drawings or constructions after others have stopped
- Shows excitement about all sorts of hands-on materials and activities
- Wants to create models to aid in understanding

Linguistic – (L)
- Reads or writes a lot, both at home and at school
- Enjoys talking, reading or writing
- Likes to learn and use new words
- Continues to read, write, or talk long after everyone else has stopped
- Prefers explanations in words

Logical-Mathematical – (LM)
- Enjoys using numbers or math concepts, both during math and other subjects
- Includes math concepts in stories, such as dimensions, time, and cause-effect relationships
- Enjoys challenging math activities
- Prefers data arranged in charts or graphs for explanatory purposes

Personal – (P)
- Introduces self or talks to visitors at home or those who come to class
- Asks personal questions of teachers, parents, relatives, other students, visitors, or people he/she doesn't know
- Enjoys reading biographies or hearing about famous people
- Writes stories, draws, or makes constructions that include people or personal relationships
- Shares personal information about him/herself
- Prefers collaborative projects
- Learns well from others

Musical – (M)
- Wants to listen to music or play it all the time
- Experiments with musical instruments for long periods of time
- Chooses musical instruments or activities when given an opportunity to select own activities

Bodily Kinesthetic – (BK)
- Constantly moving

- Experiments with Karate, gymnastics, athletic moves, dances, weight-lifting, and any other bodily kinesthetic movements he/she has observed
- Loves drama, athletics, dance, and any other activities involving body movement
- Imitates cartoon characters

3. <u>Interests</u>: Who in your class has ardent, passionate, sometimes unusual or fleeting interests?

Examples

Spatial – (S)
- Interested in models, art supplies, hands-on materials, pictures, building, sculptures, clay, blocks, art activities, video games

Linguistic – (L)
- Interested in new words in first or second language, or in other unusual languages
- Interested in stories, books, unusual words, puns, rhymes, or figures of speech
- Reads voraciously
- "Publishes" books or newsletters

Logical-Mathematical – (LM)
- Interested in puzzles, math games, logic games, chess, checkers, mastermind, battleship, dungeons and dragons
- Conducts experiments
- Categories items in a collection

Personal – (P)
- Interested in people and personal relationships
- Interested in her/himself
- Joins or forms groups to promote social change (e.g., save the wetlands)

Musical – (M)
- Interested in sounds and how they are made
- Listens intently to tones made by instruments
- Sings while doing other activities

Bodily Kinesthetic – (BK)
- Watches sports, dance, gymnastics, skating, or other events involving movement with unusual interest and intensity
- Wants to learn unusual dances, sports, or skill involving body movements

4. <u>Communication/Expressiveness</u>: Who in your class has an extraordinary ability to convey meaning through words, actions, symbols, sounds, or media?

Examples

Spatial – (S)
- Drawings, models, constructions, or paintings show feelings or abstract ideas

- Paintings show moods, feelings, or ideas in interesting ways
- Photographs capture a mood or feeling in either landscapes or pictures of people
- Combines pictures and words to clarify meaning

Linguistic – (L)
- Speaks well in first language
- Explains ideas clearly even though grammar may not be correct
- Stories (either oral or written) are unusually clear, precise, and interesting
- Oral or written directions are easy to understand
- Stories or essays convey emotions unusually well
- Uses figures of speech to clarify or extend meaning
- Uses sound, rhythm & emphasis effectively in spoken and written words

Logical-Mathematical – (LM)
- Can show or perform steps in a logic or math problem even though he/she may not be able to explain it verbally
- Explanations are clear and logical, and often or always are made with symbols, diagrams, or numbers rather than words
- Provides results of experimental studies in scientific form and vocabulary

Personal – (P)
- Words and facial or bodily expressions seem to match well (e.g., are consistent)
- Discussions of personal experiences contain unusually descriptive accounts of the emotions of self or others
- Can perform lifelike impersonations of real people or imaginary characters
- Is an actor you can "read" clearly

Musical – (M)
- Creates moods and expresses feelings or ideas through playing music
- Creates moods and expresses feeling or ideas through singing
- Makes up songs about activities or events

Bodily Kinesthetic – (BK)
- Creates or shows moods, feelings, or ideas through movement, body language, or dance
- Makes up dances, plays, or movements about activities
- Can demonstrate (act out) an idea or concept without using words so that others can guess

5. <u>Inquiry</u>: Which student or students in your class show probing exploration, observation, or experimentation with events, objects, ideas, feelings, sounds, or media?

Examples

Spatial – (S)
- Wants to touch things
- Experiments with different colors in art work
- Tries out new hands-on materials as soon as they are available
- Wants to know how things are used

- Watches carefully before trying something new

Linguistic – (L)
- Tries out new words in first or second language
- Combines vocabulary from two languages to experiment with their effects
- Enjoys playing with words or using unusual or complex vocabulary
- Usually uses words appropriately, but may try them out for effect even though the use is not exactly correct
- Looks up words in the dictionary
- Listens intently to new stories or books
- Reads to acquire information

Logical-Mathematical – (LM)
- Creates or carries out science experiments either at home or at school
- Closely observes pets or plants being grown in the classroom
- Wants to know how things work (may take things apart and not be able to put them back together)
- Asks questions such as "Why? How? When? How come?" about things and events
- Studies maps or charts to acquire information

Personal – (P)
- Asks questions such as "Why? How? When? How come?" about people and relationships
- Watches people
- Listens intently to conversations and interactions
- Tries new or unusual ways to organize groups or get things done
- Probes to discover interests and motivations of others

Musical – (M)
- Experiments with different instruments and compares sounds made by each
- Experiments with different rhythmic patterns
- Plays loud and soft, fast and slow, short and long with different tones and in different sequences

Bodily Kinesthetic – (BK)
- Experiments with movements and actions
- Experiments with personalities and characters by "becoming" the character in dress, movement, tone of voice, and bodily expressions
- Tries out new and unusual movement or activity sequences

6. <u>Problem-Solving</u>: Which student or students in your class have outstanding ability to bring order to chaos through the invention and monitoring of paths to a goal? Who enjoys a challenge?

Examples

Spatial – (S)
- Builds complex, intricate structures, or models

- Creates constructions, drawings, paintings, maps, and other visuals that closely resemble what they are intended to be
- States what he/she is going to make or draw, then completes it
- Tries new ways to build a tower or structure until the desired height or design is achieved

Linguistic – (L)

- Invents spelling for complex words or vocabulary that shows understanding of how the word sounds
- Persists in writing or rewriting a poem or story unit it sounds "just right"
- Tells or writes stories with a clear plot or a recognizable beginning, middle, and end
- Knows when to use first and second language
- Uses knowledge of grammar to figure out vocabulary
- Enjoys word problems, crosswords puzzles, Scrabble, Dictionary or other games involving words or language
- Give or writes a clear directions for reaching a goal

Logical-Mathematical – (LM)

- Solves puzzles easily and quickly
- Enjoys working on complex puzzles or games that are challenging
- Uses tangrams, pattern blocks, unifix cubes, or attribute blocks effectively to solve puzzles or logic problems
- Groups and regroups objects or ideas using multiple attributes
- Invents new ways to solve math problems
- Gets bored with easy computation problems
- Creates a logical structure for evaluating possible solutions to problems
- Follows a sequential procedure to define, investigate and solve problems
- Gets bored with easy computation problems or many similar examples

Personal – (P)

- Organizes groups to solve problems
- Proposes solutions to conflicts between people
- Enjoys working with groups on class projects
- Likes to work alone, but solves own problems effectively
- Draws on personal experiences to design a problem-solving procedure
- Applies personal standards in evaluation of problem solutions

Musical – (M)

- Enjoys challenging musical activities, such as learning to play an instrument
- Tries to play familiar tunes on instruments
- Creates challenges such as attempting to synchronize instruments or songs being played on different recorders
- Creates musical pieces with a clear beginning, middle, and end

Bodily Kinesthetic – (BK)

- Movements and actions are well coordinated
- Creates challenges such as jumping higher or farther, learning a complex move such as cartwheels or somersaults, or performing stunts on the playground
- Creates pleasing dances or movements

7. <u>Sensitivity</u>: Who in your class is unusually open, perceptive, and responsive to experiences, feelings, and others?

Examples

Spatial – (S)
- Notices colors, shapes, or variations in light
- Sees details in pictures, models, or constructions that others may miss
- Can remember visual details of the environment or of personal experiences
- Can recall/recreate visual aspects of personal experiences

Linguistic – (L)
- Notices differences in structure of first and second language
- Notices variations in meanings of words
- Shows sensitivity to rhyme, rhythm, alliteration, and other subtle aspects of language
- Notices differences and similarities between words in first, and other languages
- Seems to know when a certain word or combination of words will be better than another

Logical-Mathematical – (LM)
- Notices differences and similarities in mathematical concepts or symbols
- Sensitive to errors in logic or cause-effect reasoning
- Thoughtful observer
- Meticulous in conducting experiments

Personal – (P)
- Remembers people's names or faces
- Notices details about people or social situations that others might miss
- Responds strongly or emotionally to personal experiences
- Reacts strongly to situations perceived as unfair to self and others
- Diplomatic or tactful
- "Reads" a situation and intervenes to restore harmony among members of a group
- Seems to know the "right thing" to say or do in most situations

Musical – (M)
- Notices movements and actions that others seem to miss
- Winces or shows discomfort if a musical instrument is out of tune
- Shows discomfort when notes played or sung are not in harmony

Bodily Kinesthetic – (BK)
- Notices movements and actions that others seem to miss
- Can imitate subtle movements or action sequences
- Responds to music or sound with rhythm or movement

8. <u>Intuition</u>: Who in your class experiences sudden recognition of connections or deeper meanings without conscious awareness of reasoning or thought?

Examples

Spatial – (S)

- Notices connections when looking at pictures, making constructions, painting, drawing, or creating visual images
- Sees connections between images, shapes, colors, or other visual stimuli
- May not be able to explain the connections with words
- Sees the form of a visual representation for conveying and idea/image
- Knows where he or she is in relation to other environmental elements

Linguistic – (L)

- Notices connections when talking, reading, listening to explanations of ideas, or when thinking about ideas
- Sees connections between ideas, generalizations, and abstract linguistic concepts
- Interrupts others to share insights
- May not be able to explain the insight immediately or in terms understandable to others

Logical-Mathematical – (LM)

- Notices connections when talking, reading, listening to explanations of ideas, or when thinking about ideas
- Sees connections among mathematical concepts or abstract ideas
- May not be able to explain the connection with words
- Gets correct answers to math problems without working out the solution (e.g., long division, multiplication, algebra, geometry)

Personal – (P)

- Notices connections when working with people or when working alone
- Has insight about personal interactions, social concepts, or about him/herself
- Recognizes the "moment" when another person needs support

Musical – (M)

- Notices connections while listening to music
- Notices connections while playing or creating music
- Makes connections about sounds or songs heard in the past and those being listened to now
- May not be able to explain connections with words

Bodily Kinesthetic – (BK)

- Notices connections when dancing, playing sports, or when involved in movement experiences
- Makes connections between dancing and athletics, drama and gymnastics or other activities involving movement
- May not be able to explain connections with words

9. <u>Reasoning</u>: Which student or students in your class have outstanding ability to think things through and consider implications or alternatives? Who exhibits rich, highly conscious, goal-oriented thought?

Examples

Spatial – (S)

- Gathers and organizes materials before beginning a painting, drawing, model, or construction
- States "I am going to make _____," and continues until goal is reached to her/his satisfaction
- Does not explain reasoning, but shows it through work on constructions, drawings, or paintings
- Draws or makes visual models before providing verbal explanations
- Clearly knows how to get from point A to point B in the most efficient way

Linguistic – (L)
- Talks about own actions or thoughts, either in first or second language
- Identifies many alternatives during brainstorming
- Makes predictions and inferences, and can explain why one prediction might come true and another might not
- Uses speech to communicate goals and procedure to self and others

Logical-Mathematical – (LM)
- Completes math games and puzzles systematically
- Organizes materials and makes plans for science experiments, projects, or other activities
- Often does things in a step-by-step way
- Connects cause to phenomenon or predicts effects of specific actions

Personal – (P)
- Reminds others in the group when they have forgotten their task
- Helps group members choose parts of a task to complete a cooperative activity
- Develops plans for completing independent projects or other individual activities
- Works well alone completing self-chosen activities and meeting personal goals
- Knows what he/she wants to do as an adult and works toward that goal

Musical – (M)
- Says (for example) "I am going to make up a new song" and then continues until goal is accomplished
- Tries out tones and rhythms until he/she can accurately play a familiar tune
- Experiments with instruments or voice until desired effect is achieved

Body Kinesthetic – (BK)
- Says "I am going to learn to ride a tricycle," and continues until he/she is successful
- Makes things or imitates movements before talking about them
- Tries out movements and expressions until a desired effect is created

10. <u>Imagination/Creativity</u>: Which students in your class have an extraordinary capacity for ingenious, flexible use of ideas, processes, or materials?

Examples

Spatial – (S)
- Creates colorful or unusual paintings
- Builds structures or models using materials in unusual ways
- Makes many different drawings, paintings, or constructions

- Adds interesting details to drawings, paintings, or constructions

Linguistic – (L)
- Combines words or concepts from first and second language in unusual ways
- Uses words of second language in interesting, but not necessarily correct ways
- Tells interesting stories
- Uses unusual words, phrases, or descriptions
- Writes poetry, stories, descriptions, or essays that are unusual or original
- Uses rhythm, rhyme, alliteration, and other subtle aspects of language when speaking or writing

Logical-Mathematical – (LM)
- Makes up new ways to play games
- Designs new ways to solve puzzles or do logic problems
- Comes up with unusual solutions to math problems
- Creates puzzles or math problems
- Uses math manipulatives in unusual ways
- Designs new experiments to test hypotheses
- Combines elements in unusual ways

Personal – (P)
- Suggests new ways for groups to work together
- Tries unusual ways to get things done
- Has many different ideas for reaching a goal, regardless of whether it is personal or collective

Musical – (M)
- Creates unusual, pleasing songs with voice or instruments(s)
- Plays instruments(s) while singing
- Plays several instruments in unusual and interesting sequences
- Creates unusual rhythmic patterns

Bodily Kinesthetic – (BK)
- Body movements are flexible, varied, graceful, and often unusual
- Can make up many different ways to move from place to place
- Expresses opposite qualities through movement, such as fast/slow, strong/weak, tight/loose

11. <u>Memory/Knowledge/Understanding</u>: Who in your class has an unusual capacity to acquire, integrate, retain, and retrieve information or skills?

Examples

Spatial – (S)
- Remembers and uses new art techniques
- Uses maps, globes, and visual aids better than others in the class
- Finds her/his way to or from new places easily after going there only once

Linguistic – (L)

- Remembers and uses new words accurately after hearing or reading them only once
- Use of the first language is advanced for age, although it may not always be correct
- Knows a lot of information about many things
- Can retell stories, experiences, videos, or movies accurately and with many details
- May be the best student in reading or language arts in his or her first language

Logical-Mathematical – (LM)
- Remembers complex strategies
- Works puzzles no one else can do
- Remembers and uses math concepts that others in the class have not yet learned or cannot understand
- May be the best student in understanding math but gets bored with computation problems
- Can construct a logical or philosophical explanation

Personal – (P)
- Seems to know what motivates people
- Remembers information and principles related to people, groups, and societies
- May be the best student in social studies
- Shows unusual or sophisticated understanding of her/himself
- Shows unusual or sophisticated understanding of how groups can work together
- Understands how groups or individuals can resolve conflicts

Musical – (M)
- Remembers and repeats complex tonal patterns
- Remembers and repeats complex rhythmic patterns
- Has perfect pitch in voice, and can match tones in instruments or between instruments and voice(s)

Bodily Kinesthetic – (BK)
- Remembers and repeats complex movement patterns
- Remembers and repeats complex dances or athletic activities
- Moves body parts in isolation or moves whole body in a coordinated way when necessary
- Coordinates body even when near the floor
- Imitates sports figures, dancers, or actors accurately

12. <u>Learning</u>: Who in your classroom has the ability to acquire sophisticated understanding with an amazing speed and apparent ease?

Examples

Spatial - (S)
- Draws or paints like children much older
- Creates constructions using symmetry, perspective, composition, or complementary colors in ways that are advanced for her/his age
- Can put something back together after taking it apart
- Needs little practice to acquire advanced techniques

Linguistic – (L)
- Learns a second language quickly

- Combines vocabulary for first and second languages to explain ideas
- Learns to read quickly or without being taught
- Knows letters, sounds, and meanings that are advanced for his/her age
- Uses complex sentence structure or vocabulary in first language
- Uses varied and interesting forms for writing (e.g., non-rhyming poetry, acrostics)
- Recognizes similarities among languages
- Understands the structure and conventions of language

Logical-Mathematical – (LM)

- Works math and logic problems like children who are older
- Learns how to do new puzzles quickly or without being taught
- Learns new math skills quickly or easily
- Understands scientific classification
- Explains similarities and differences among objects/ideas and categories

Personal – (P)

- Learns new group skills easily and quickly
- Gets to know people, both classmates and adults, quickly and easily
- Knowledge of self is unusual for his/her age and grade
- Applies social rules in sophisticated and advanced ways
- Classroom behaviors indicate an advanced level of metacognitive monitoring of his/her work

Musical – (M)

- Learns songs and tone patterns quickly and easily
- Can pick out, sing, or recognize a new tune accurately after hearing it only once
- Learns to play an instrument quickly and easily when given an opportunity

Bodily Kinesthetic - (BK)

- Learns complex movements, dances, or athletic skills quickly or easily
- Can relax totally and tighten completely as needed
- Can repeat movement, dance, or athletic skill sequences accurately after seeing them only once

Student Strength Assessment
Teacher Interview Form
C. June Maker, Ph.D.
Department of Special Education and Rehabilitation
The University of Arizona

Teacher: _____School: _____Grade: _____ Interviewer: _____Date: _____

Students	Characteristics														
	Humor	Motivation	Interests	Communication/ Expressiveness	Inquiry	Problem Solving	Sensitivity	Intuition	Reasoning	Memory/ Knowledge/ Understanding	Learning	Total			
												L	LM	S	P
1.															
2.															
3.															
4.															
5.															
6.															
7.															
8.															
9.															
10.															
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13.															
14.															
15.															

Student Strength Assessment
Teacher Interview Form
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Teacher: _____School: _____Grade: _____ Interviewer: _____Date: _____

Students	Characteristics														
	Humor	Motivation	Interests	Communication/ Expressiveness	Inquiry	Problem Solving	Sensitivity	Intuition	Reasoning	Memory/ Knowledge/ Understanding	Learning	Total			
												L	LM	S	P
16.															
17.															
18.															
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21.															
22.															
23.															
24.															
25.															
26.															
27.															
28.															
29.															
30.															

Appendix D:
Suggested Activities for Observing Children's Problem Solving in Different Ability Areas

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Appendix 1A.i

Practical teacher observational checklist outlining the core characteristics specific to each human ability

EARLY YEARS SPECIFIC PROBLEM-SOLVING ABILITIES

NOTE: These characteristics are in line with the Foundation Stage Profile and Key Stage 1 (UK).

1. Social Potential **Characteristics:** • shows empathy with others • gets on well with others • shows patience with others • involves or considers others in decision-making • considers others when expressing own feelings • leads and/or follows as appropriate	**Activities for observation:** • games involving other people • cooperative play activities • playground behaviour • dance, drama and mime activities • small group work
2. Emotional Potential **Characteristics:** • identifies and describes own feelings • identifies causes and effects of own feelings • expresses and releases negative emotions • sees the effects of expressing emotions in certain ways	**Activities for observation:** • discussions about behaviour of characters in stories • games • dance, drama and mime activities • playground behaviour • discussions about highly emotional topics
3. Spiritual Potential **Characteristics:** • aware of reactions of others (also social) • concerned about 'fair play' • settles arguments (also social) • is a peacemaker • asks questions about living and dying • shows openness to all points of view on religious questions • wonders about universal questions	**Activities for observation:** • cooperative activities • discussions of social behaviour • drama and role-play activities • playing or working in groups • discussions of moral dilemmas
4. Linguistic Potential **Characteristics:** • uses advanced vocabulary with understanding • can use prepositions and comparisons to explain connections between ideas • shows understanding in dual language • often has a dialogue with the print • discusses a story at length	**Activities for observation:** • telling a story from pictures • playing word and picture games • telling a story with fluency and expression • performing detailed 'show and tell' • recalling an event with detail

5. Mathematical Potential **Characteristics:** • retains what is learned and can apply learning to solve mathematical problems • solves complex mathematical puzzles • creates unusual patterns • sees relationships and connections among numbers, symbols and/or shapes • remembers sequences of numbers and symbols • can work forwards and backwards through a sequence • makes mathematical comparisons	**Activities for observation:** • pattern and shape puzzles • matching and sorting puzzles • weighing and measuring problems • games of logic • games of strategy
6. Scientific Potential **Characteristics:** • likes experimenting with plants, animals, chemicals, or environments • notices fine details in natural phenomena • likes solving science problems • builds and makes models of scientific information or ideas • spots inconsistencies	**Activities for observation:** • collecting and grouping things • investigation activities • sequence activities • building and making models
7. Mechanical/Technical Potential **Characteristics:** • takes things apart • enjoys building and making devices • wants to see the inside workings of things • fixes machines or devices	**Activities for observation:** • Lego and Multifix activities • designing and drawing activities • using toys with moving parts • building and making activities
8. Visual/Spatial Potential **Characteristics:** • solves hands-on problems easily • spots visual similarities and differences • creates unusual visual patterns • constructs or draws with detail and perspective • spends a long time looking at pictures, diagrams, maps	**Activities for observation:** • do and make activities • building activities • drawing and painting activities • 3D, tangram and jigsaw puzzles
9. Auditory Potential **Characteristics:** • responds to melody and rhythm • distinguishes sounds and tones accurately • learns melodies easily • shows observable responses to different musical modes • recognises when voices or instruments are 'in tune'	**Activities for observation:** • dance and drama activities • song and band activities • clapping and rhythm games • musical games • listening activities
10. Somatic/Physical Potential **Characteristics:** • has good hand–eye coordination • moves with grace and fluency • moves creatively • controls gross- and fine-motor movement • has accurate sense of timing and direction • changes pace smoothly • distinguishes flavours accurately • distinguishes tastes accurately without looking • mimes with accuracy and expression	**Activities for observation:** • games requiring large- or fine-motor movement • obstacle courses • dance, drama and mime activities • hand–eye coordination activities • tactile boxes • taste samples

Appendix 1A.ii

Practical teacher observational checklist outlining the core characteristics specific to each human ability

KEY STAGE 2 SPECIFIC PROBLEM-SOLVING ABILITIES

NOTE: These characteristics are in line with the Key Stage 2 (UK) National Curriculum Framework.

1. Social Potential **Characteristics:** • shows empathy with others • understands rules and guidelines • sees cause and effect of happenings • involves or considers others in decision-making • considers others when expressing own feelings • leads and/or follows as appropriate	**Activities for observation:** • games involving other people • role-play activities • playground behaviour • dance, drama and mime activities • small group work • discussions of issues and behaviour
2. Emotional Potential **Characteristics:** • identifies and describes own feelings • identifies causes and effects of own feelings • expresses and releases negative emotions • sees the effects of expressing emotions in certain ways	**Activities for observation:** • discussions about behaviour of characters in stories • games • dance, drama and mime activities • playground behaviour • discussions about highly emotional topics
3. Spiritual Potential **Characteristics:** • understands symbolism • concerned about 'fair play' • settles arguments (also social) • is a peacemaker • asks questions about human values • shows openness to all points of view on religious questions • wonders about universal questions	**Activities for observation:** • cooperative activities • discussions of social behaviour • drama and role-play activities • playing or working in groups • discussions of moral dilemmas
4. Linguistic Potential **Characteristics:** • uses advanced vocabulary and structures accurately and creatively • can use complex structures to sequence and explain ideas • shows understanding in dual language • empathises with characters and issues • identifies differences in purposes and styles	**Activities for observation:** • summarising a story extracting key points • devising word games • telling a story with fluency and expression • performing drama and role play • recalling an event with detail

5. Mathematical Potential **Characteristics:** • remembers and generalises mathematical rules • solves multiple-step problems • uses unusual sequences • sees relationships and connections among numbers, symbols and/or shapes • investigates patterns or sequences • can work forwards and backwards through a sequence • makes mathematical comparisons	**Activities for observation:** • multi-level pattern and shape puzzles • multiple criteria matching and sorting puzzles • open-ended, multiple-step problems • games of logic • games of strategy
6. Scientific Potential **Characteristics:** • likes experimenting with plants, animals, chemicals, or environments • notices fine details in natural phenomena • see connections, collects data, uses evidence • builds and makes models of scientific information or ideas • spots inconsistencies	**Activities for observation:** • collecting and grouping things • investigation activities • sequence activities • building and making models
7. Mechanical/Technical Potential **Characteristics:** • uses tools and techniques with accuracy • manipulates techniques creatively • enjoys building and making devices • manipulates shapes, rotation, angles • fixes machines or devices	**Activities for observation:** • Lego and Multifix activities • designing, making and drawing activities • making and manipulating moving structures
8. Visual/Spatial Potential **Characteristics:** • solves hands-on problems easily • spots visual similarities and differences • experiments with techniques and methods • constructs or draws with unusual detail and perspective • uses shapes, textures, tones creatively • experiments with 2D and 3D ideas	**Activities for observation:** • construction/design activities • observation activities • drawing, painting, texture and tactile activities • multi-level 3D, tangram and jigsaw puzzles
9. Auditory Potential **Characteristics:** • responds to melody, rhythm and beat • interprets sounds and tones accurately • learns melodies easily • recognises moods and qualities of sounds • recognises voices and body music as expressive instruments	**Activities for observation:** • dance and drama activities • song and band activities • clapping and rhythm games • musical games • listening activities
10. Somatic/Physical Potential **Characteristics:** • has accurate sense of space, speed, direction and shape • links movements and sequences fluently • has wide repertoire of skills and movements • has good control of gross and fine movement • responds to flavours and textures accurately • mimes with accuracy and expression • expresses feeling, moods, ideas expressively	**Activities for observation:** • games requiring large- or fine-motor movement • obstacle courses • dance, drama and mime activities • multi-sequence movements • taste and texture puzzles

Appendix E:
Checklist of Observable *General* Problem Solving Characteristics to Supplement Checklists of *Specific* Characteristics Included in Appendix D to Observe the Activities Suggested in Appendix D

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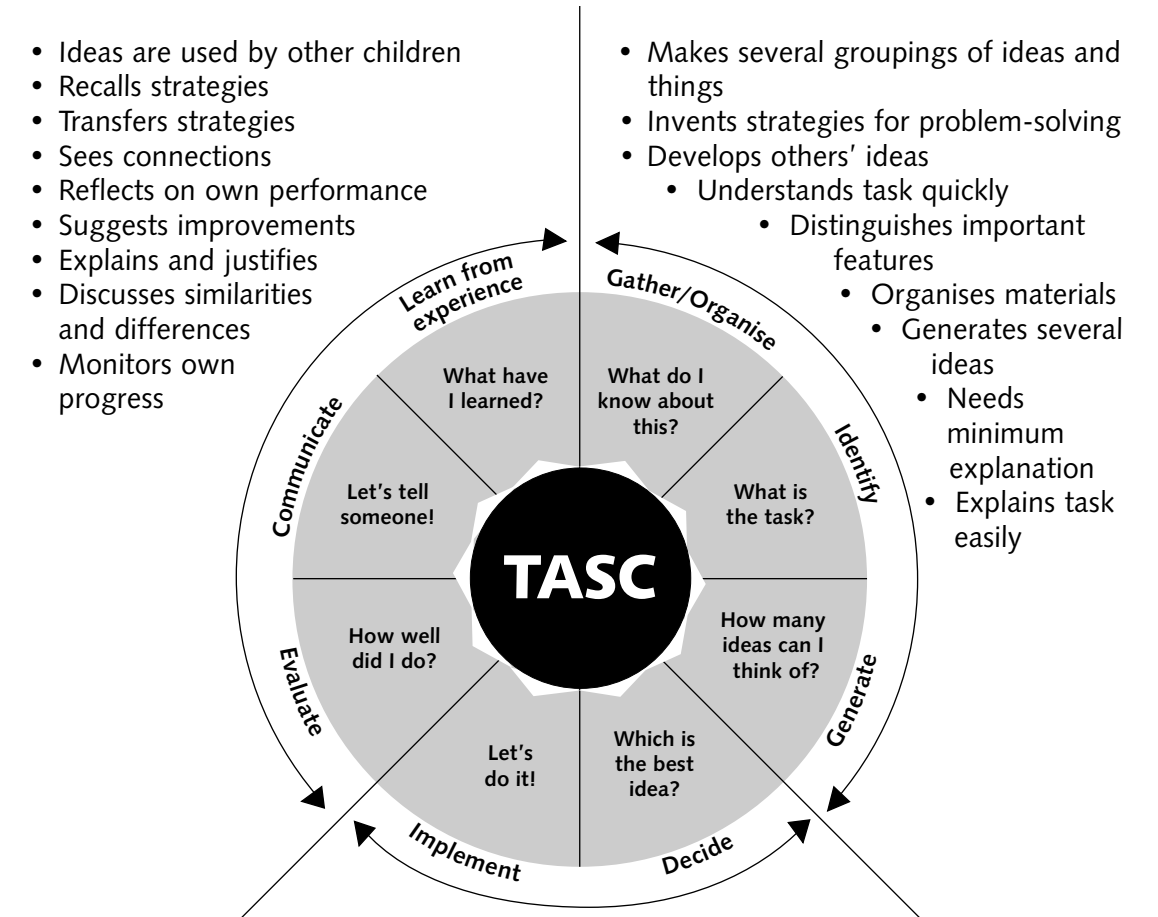
Appendix 1

Appendix 1A

Practical teacher observation checklist outlining *general problem solving* abilities (identified through DISCOVER/TASC observations)



Appendix F:
Teaching Unit for Early Elementary Students Based on the DISCOVER Curriculum Model

Habitats
The Desert

A Unit for Teaching Science to Primary Students

By

Beatrice Ruiz DeLeya

Every creature and every plant in this world lives in a different environment; they all learn to adapt and to survive.

Overview

I have a class with students who are eager to learn and to explore. My class is always willing to learn new things therefore I have created a unit about the desert environment. Since we live in the desert it was very fun to look for activities where the students feel familiar and are able to use their background knowledge. My class consists of 20 students where 1/4 is gifted or at least highly creative and talented, and the rest are average students who like to work hard and enjoy learning. I have a bilingual class where most of the students come from Mexico from a low socio-economic status. It is important to mention this since some of the lessons that I will be guiding are probably too simple for other students but my students need the exposure to many different things in order to truly understand the objective.

This unit is designed to help students appreciate the importance of our world and how different habitats make up our daily lives. Children will understand at the end of the unit how our simple routines are part of adaptation, and also how our world is made up of different habitats. It is important for them to see how even in the same habitat—the desert, animals and people around the world adopt in a different form.

The goals of the unit will be accomplished by using a problem continuum where the students will work on very easy and known solutions to a very complex problem solving strategies. I will include lessons also that use different thinking strategies within the continua such as Taylor's Multiple Talent Approach, Taba's Teaching Strategies, Bloom's Cognitive Taxonomy, Krathwohl's Affective Taxonomy, and Parnes' Creative Problem Solving. By using a variety of models I will encourage the flexibility that a student might need to enhance their learning. I enjoy as much as my students the questioning strategies that Hilda Taba uses while teaching. The different approaches that Taylor uses are ideal for the students who might have different talents such as academic, productive thinking, communication, forecasting, and decision making and planning. All the models are excellent sources to enhance students to learn through multiple ways and specially allow students to learn by themselves and not only through the teacher . . .

Population Description

This unit is designed for a regular classroom with some modifications for gifted students. In my classroom I have 5 gifted students, as well as 2 learning disabled children, while the rest of the class are regular students who like to learn new things every day. I consider that all my students are high achievers and risk takers. Right now I have 20 students whom are all Hispanic. This unit could also be use in a self-contained classroom of gifted students. The ideal way to present this unit would be over a period of 5 weeks for about 1 hour daily.

Management Model

This unit will be designed under Joseph S. Renzulli's Enrichment Triad management model. I liked how Renzulli's model offers the opportunity to move from an activity for non-gifted students to a stage where gifted students have the opportunity to shine. This is also a model that promotes teamwork, interaction, individual accountability, equal participation, and responsibility. By using this model and strategies I will teach children to become independent learners, and to become independent researchers.

I will not expect every activity to be done from every child. I will introduce the lesson with a type I activity and depending on the class' understanding I will do type II maybe in groups. The students will then have a menu to choose from. I will put activities II, III, and IV to be done in centers. They may choose to do them in any particular order. Type V activity will be offered as a bonus activity which can either be presented to the whole class or only to the teacher. I will be grading only two out of the five activities and students may be allowed to create their own portfolio to be graded with their best job. Since most of the time I will do activity I with them they only have four others to work on. The portfolio must include a variety of activities throughout the unit and at least two from each intelligence. I will hold regular interviews with each student to discuss why they choose a particular activity to be graded. I think that it is important to take into account the reasoning of each child . . . after all it is their work.

Unit

The basic theme, generalization, and objectives of this unit are abstract, complex, and varied enough to give the child the opportunity to explore the topic and to choose a project of their own for further investigation. I will be making some adaptations in the content for the children who are learning disabled and for those students who cannot reach as high as some of their peers. I think that by using the learning continua I can be more flexible and my students will be able to achieve more. Also, I think that since activities in type I are so simple many of the disabled students will be more able to achieve higher in the unit. During the process activities, I will aim for higher level thinking, open ended questions and answers, I will provide opportunities for discovery, reasoning and choice. The products will be from real problems or situations, the students will make presentations to their peers as well as other audiences and will transform their knowledge to a product that will be shared to all. The five problem solving activities that will be done during the unit allow for a range of products with a variety of processes. As far as the learning environment goes I will provide the materials for their activities. I will also arrange the students into small groups to encourage participation and enough time to resolve the problems. The unit is student centered, allows for independence as well as interdependence, it is open to exploration, offers flexibility and high mobility.

Theme: Habitats
Topic: Deserts
Sub-topic: Sonoran Desert

Generalization: Groups of organisms, plants or people that live together, in one place, learn to adapt to their environment. Altering any part of the habitat will affect the lives of the flora and fauna.

Unit duration: Approximately 4 weeks

Content Objectives:

- Habitat
- Sonoran-Desert
- Deserts: Sonoran, Sahara, Chihuahua, Acatama, Turkesan, Australia, Arabian
- Temperature
- Types of deserts: sandy, rocky
- Plants: succulents—orange pipe cactus, saguaro cactus, barrel cactus, century plant, prickly pear, Mexican poppy, cholla, yucca, mesquite, palo verde
- Animals: honey ant, pinacate beetle, golden wheel spider, scorpion, gecko lizard, gila monster, desert tortoise, horned lizard, western diamondback rattlesnake, sidewinder rattlesnake, hawk, gila woodpecker, elf owl, roadrunner, jackrabbit, kangaroo, rat, javelina, coyote, bobcat, badger, dromedary camel, bactrian camel
- Natural resources
- Oasis
- Water

Data:

- Books
- Videotapes
- Audiotapes
- Magazines (articles about the desert or such as *Tucson Lifestyle*)
- Students prior knowledge about the desert
- Fieldtrip to Sonoran Desert Museum
- Internet sites about the desert

Process Objectives:

1. **Higher Levels of thinking:**
   - The student will apply and extend rules and concepts within and across content areas. The student will see by doing different activities how our desert environment affects our lives.
   - The student will apply the principles and generalizations within and across content areas. The students will through different activities applies their knowledge about the desert, expand it, and arrive at generalizations. The teacher will also give them at the beginning a generalization and then

students will explain how do they think that the generalization makes sense and why.

2. **Critical thinking:**
   - The student will distinguish between fact and opinion.
   - The student will distinguish between irrelevant from relevant.
   - The student will determine the credibility of the source.
   - The students will identify underlying assumptions.

Learning Environment Goals:

In this unit I will present to the students with different activities that will provide them with opportunities to learn about the desert. Most students will expand prior knowledge and construct new knowledge. The activities will range in the degree of difficulty from the known to the unknown. By integrating learning continua the teacher offers the students the opportunity to do activities that are more challenging and interesting rather than boring and repetitious. I will also try to accommodate the students into groups of four to allow for cooperative learning, which I believe is very important especially at this young age.

Tentative Schedule:

Intelligence	Type I	Type II	Type III	Type IV	Type V
Linguistic	1. Look at the drawings and then draw a line to the matching word. Name the parts of a plant in the following picture	1. Fill in the blank spaces of the paragraph below. Choose the correct word from the word box below. 2. Read the story "My mother is the desert" and then answer the following questions.	1. Using your vocabulary words create a story about a desert creature. Choose from any of the books from the basket and read it. Then write a summary of the story including beginning, middle, problem and ending.	1. Write a report about the desert. 2. Using power point make a presentation of the things that you learned about the desert. Write a descriptive paragraph after each picture. Imagine you've been in the desert for a couple weeks now and you have time to write a letter to your friends or family about your adventure.	Today you will need to gather information to present to a panel of environmentalist and discuss about how your school can help to protect the desert environment.
Spatial					
Logical Mathematical	2. Using the desert-number cards, play with a partner to practice your multiplication facts. (LM 1) 3. Answer the multiplication and division facts paper.	Multiplication booklet. In each page the student needs to stamp the correct number of flowers in each cactus branch to match the number sentence. Also, they will write the answer at the end of the number sentence. Word problems. Answer the word problems. (LM-2)	1. Graphing Skills. Students can make different graphs such as making a list of their favorite desert animals and then voting for them. 2. Create 5 different word problems using either multiplication or division and give them to a friend. 3. Make a Venn diagram to compare a	1. Create a secret alphabet using pictorials from the desert. Write a secret message to a friend. 2. Create a coordinate grid with a map of a desert. Include things like an oasis, a camel and give the exact number of pairs to find them.	1. Write a poem about anything from the desert following the pattern of any of the poems that we have studied. 2. You are going to go in a trip to the desert. Some animals are better than other are without water or food. Make a list of these animals.

			desert habitat with any other habitat.	3. Make a desert scene but brake all your pieces in fractions. Write the fraction for each piece.	Which animal would you take and why. Explain the probability of surviving in the desert.
Musical	Clap as you read the story: "Here is the Southwestern Desert." At the end of each line write how many syllables the sentence has.	Listen to the tape "In the shade of the Saguaro" by Patty Horn. Choose one to sing along with a friend.	Listen to the song "Down by the Bay." Change the lyrics to fit a desert scenario	Create a musical play using creative characters from the desert.	Some native tribes that live in the desert have specific dances that express their gratitude or feelings to nature. Create a song, poem or dance to express something that is important to you.
Spiritual					
Intrapersonal					
Interpersonal					
Bodily-Kinesthetic					
Naturalistic					

Lesson Plans:

MATRIX OF PROBLEM SOLVING TYPES AND MULTIPLE INTELLIGENCES

Theme: Habitats
Topic: Deserts
Generalization: Every living thing needs a special place to live in this world. Humans as well as animals and plants learn to adapt to their own environment.
Literature focus: *America's Deserts* - by Marianne Wallace, *Cactus in the Desert* - by Phyllis Busch, *A Desert Scrapbook* - by Virginia Wright
Intelligence: Linguistic

Arizona State Standards	**Problem Types I - V**
4SC-F3. Identify the basic structures and functions of plants and animals. RF3. Use reading comprehension strategies such as drawing conclusions, summarizing, making predictions, identifying cause and effect, and differentiating fiction from non-fiction.	1. Look at the drawings and then draw a line to the matching word. (L1.1) 2. Name the parts of a plant in the following picture. (L1.2)
RF3. Use reading comprehension strategies such as drawing conclusions, summarizing, making predictions, identifying cause and effect, and differentiating fiction from non-fiction.	1. Fill in the blank spaces of the paragraph below. Choose the correct word from the word box below. (L2.1) **2.** Read the story *A Desert Scrapbook* by Virginia Wright, then answer the comprehension questions. (L2.2)
R-F4. Identify facts and the main idea, sequence events, define and differentiate characters, and determine an author's purpose in a range of traditional and contemporary literature.	1. Using your vocabulary words create a story about a desert creature.(L3.1) 2. Choose from any of the books from the basket and read it. Then write a summary of the story including beginning, middle, problem and ending. (L3.2) 3. Write a triangular poem. In the middle draw or paste a picture of your plant or animal. (L3.3)
W-F3. Write a personal narrative or a creative story that has a beginning, middle and end and uses descriptive words or phrases to develop ideas and advance the characters, plot and setting. W-F4. Gather, organize and accurately, clearly and sequentially report information gained from personal observations and experiences such as science experiments, field trips and classroom visitors. W-F5. Locate, acknowledge and use several sources to write an informational report in their own words.	1. Write a report about the desert. **2.** Using PowerPoint make a presentation of the things that you learned about the desert. Write a descriptive paragraph after each picture. **3.** Imagine you've been in the desert for a couple weeks now and you have time to write a letter to your friends or family about your adventure
W-F4. Gather, organize and accurately, clearly and sequentially report information gained from personal observations and experiences such as science experiments, field trips and classroom visitors. W-F5. Locate, acknowledge and use several sources to write an informational report in their own words.	**1.** Today you will need to gather information to present to a panel of environmentalists and discuss with them about how your school can help to protect the desert environment.

Theme: Habitats
Topic: Deserts
Generalization: In order to survive living things need to protect themselves from its predators; many times it can be done through colors, patterns or shapes.
Literature focus:
Intelligence: Logical Mathematical

Arizona State Standards	**Problem Types I-V**
1M-F5. Demonstrate proficiency with the operations of multiplication and division of single digit numbers.	1. Using the desert-number cards, play with a partner to practice your multiplication facts. (LM1 1.1) 2. What are some shapes that you might see in a desert scene? (LM 1.2)
1M-F3. Understand the meaning for and application of the operations of addition, subtraction, multiplication and division.	1. Multiplication booklet. In each page the student needs to stamp the correct number of flowers in each cactus branch to match the number sentence. Also, they will write the answer at the end of the number sentence. (LM2.1) 2. Using pattern blocks describe some patterns that we can find in the desert such as the diamondback rattlesnake. (LM-2.2)
1M-F3. Understand the meaning for and application of the operations of addition, subtraction, multiplication and division. 2M-F2. Construct, read and interpret displays of data to make valid decisions, inferences and predictions. 1M-F5. Demonstrate proficiency with the operations of multiplication and division of single digit numbers.	1. Graphing Skills. Students can make different graphs such as making a list of their favorite desert animals or how many certain animals are in the desert. They can also do this in the computer. Students need to be able to interpret the graph. (LM3.1) 1. Coordinate Grids. Create a coordinate grid with a map of a desert. Include things like an oasis, a camel and the exact number of pairs to find them. 2. (LM3.2) 3. Make a Venn Diagram to compare a desert habitat with any other habitat such as the tundra.
1M-F1. Represent and use numbers in equivalent forms through the use of physical models, drawing word names and symbols. 1M-F3. Understand the meaning for and application of the operations of addition, subtraction, multiplication and division. 1M-F6. Add and subtract commonly used fractions and decimals.	1. Create a secret code using pictorials from the desert. Write a secret message to a friend. 2. Make a desert scene but break all your pieces in fractions. Write the fraction for each piece.
2M-F2. Construct, read and interpret displays of data to make valid decisions, inferences and predictions. 6M-F4. Interpret statements made with precise language of logic.	1. Invent a math game to play in the desert. 2. You are going on a trip to the desert. Make a list of the things that you would need to survive. Range them from the most needed to the least needed. Also, which animal would you take and why? Explain what is the probability of surviving in the desert.

Theme: Habitats
Topic: Deserts
Generalization:
Literature focus: Prey and Predators
Intelligence: Bodily-Kinesthetic

Arizona State Standards	**Problem Types I-V**
4SC-F3. Identify the basic structures and functions of plants and animals.	1. Pick an animal from the video and imitate in slow motion how it moves.
4SC-F3. Identify the basic structures and functions of plants and animals.	1. Using your body describe an animal as close as possible.
4SC-F1. Describe and explain cause and effect relationships in living systems. 4SC-F4. Identify characteristics of plants and animals that allow them to live in specific environments.	1. As a class play the game "Food Chain" from the Project Wild Book.
4SC-F3. Identify the basic structures and functions of plants and animals. 4SC-F1. Describe and explain cause and effect relationships in living systems. 4SC-F4. Identify characteristics of plants and animals that allow them to live in specific environments.	1. The game was played only with "Land" animals. Change the rules to include a larger variety such as birds.
4SC-F4. Identify characteristics of plants and animals that allow them to live in specific environments.	1. Working in pairs, create a frozen scene of a predator and its prey.

Theme: Habitats
Topic: Deserts
Generalization: Many cultures express their most important beliefs and traditions through their bodies.
Literature focus: Native American dances
Intelligence: Bodily-Kinesthetic

Arizona State Standards	**Problem Types I-V**
1SS-F1. Demonstrate everyday life in the past and recognize that some aspects change and others stay the same.	1. Students will watch a video of a Native American dance; then they will learn some specific, basic steps from that particular dance.
1SS-F3. Uses stories to describe past events, people and places.	1. The class will learn to dance one particular Pascua Yagui dance.
1SS-F1. Demonstrate everyday life in the past and recognize that some aspects change and others stay the same. 1SS-F3. Uses stories to describe past events, people and places.	1. In their groups the students will choose a particular new dance from the videos that we have been observing. They will break it down to equal parts and rehearse it to the whole class.
1SS-F3. Uses stories to describe past events, people, and places.	1. The class will view the video of the Yagui's Deer Dance. The students will now create a dance for a different animal or dance a different ending.
1SS-F3. Uses stories to describe past events, people and places.	1. We have observed several videos of Native American dances. Through their dances they portray their culture and an important message. Create a dance to show your ideas about the desert or something that is important to you about the desert habitat. You may work in pairs or trios.

Theme: Habitats
Topic: Deserts
Generalization: Our world is made up of great, big things as well as tiny ones, we need to learn to appreciate them all.
Literature focus:
Intelligence: Naturalistic

Arizona State Standards	Problem Types I-V
4SC-F3. Identify the basic structures and functions of plants and animals.	1. Walk outside and observe carefully everything that you see. Write a list of all the things that you find, and separate them into your five senses. 2. Pick a picture from the book Desert Wildlife of Southwest and color it according to the paragraph below each drawing.
4SC-F3. Identify the basic structures and functions of plants and animals. 3SC-F4. Identify characteristics of plants and animals that allow them to live in specific environments.	1. Make a picture booklet of either desert plants or desert animals that you find as we walk outside. On each page include one drawing and the proper names. 2. Imagine that you could use a pair of binoculars to see with greater detail your scene. Write a paragraph to describe, very eloquently, what you are observing.
4SC-F2. Trace the life cycles of various organisms. 4SC-F7. Explain the interaction of living and nonliving components of ecosystems.	1. After learning about the water cycle in the desert, draw a flow chart to show this cycle. 2. Take a closer look at these animals' footprints. Please classify them in two different categories. 3. As we walk in the desert we are able to hear many different noises. Listen carefully and make a list of all the noises that you hear, try to guess who is making it.
4SC-F3. Identify the basic structures and functions of plants and animals. 4SC-F4. Identify characteristics of plants and animals that allow them to live in specific environments. 4SC-F2. Trace the life cycles of various organisms. 4SC-F7. Explain the interaction of living and nonliving components of ecosystems.	1. Many people who live in the desert abuse the consumption of water. Water should be taken more seriously and be use only when needed. How does the abuse of water affect the desert habitat? Explain the water table in this habitat. 2. The desert is characterized by having a large population of nocturnal animals. Imagine that you spend one night camping in the desert. Write your journal your experience. Include something about the food chain, prey and predators and everything that you see.

Theme: Habitats
Topic: Deserts
Generalization:
Literature focus:
Intelligence: Spatial

Arizona State Standards	Problem Types I-V
1SC-F2. Construct a model (e.g., a volcano) that illustrates simple concepts and compare those models to what they represent.	Type I: **Using colored sand, make a drawing of an accurate desert scene that you saw in the postcards.**
1SC-F2. Construct model (e.g., a volcano) that illustrates simple concepts and compare those models to what they represent.	Type II: **Using any material from the art box, create an accurate 3-D model of a plant that lives in the desert.**
1SC-F2. Construct model (e.g., a volcano) that illustrates simple concepts and compare those models to what they represent. 2SC-F1. Recognize that scientific contributions have been made by all kinds of a people everywhere in the world.	Type III: **Create an artifact that might be useful to you if you were lost in the desert.**
1SC-F2. Construct model (e.g., a volcano) that illustrates simple concepts and compare those models to what they represent.	Type IV: **Create a 3-D model of any desert that we have studied. You may use any material that you wish.**
1SC-F2. Construct model (e.g., a volcano) that illustrates simple concepts and compare those models to what they represent. 4SC-F1. Describe and explain cause and effect relationships in living systems. 4SC-F3. Identify the basic structures and functions of plants and animals. 4SC-F4. Identify characteristics of plants and animals that allow them to live specific environments. 4SC-F7. Explain the interaction of living and nonliving components with ecosystems.	Type V: **We've been discussing how to "save our planet;" now design anything that will give us more ideas about how to save our planet.**

Theme: Habitats
Topic: Deserts
Generalization: Every place where we live has its own music, sounds and whisper.
Literature focus: Here
Intelligence: Spatial

Arizona State Standards	Problem Types I-V
RF-1. Use phonemic skills to decode words.	**Clap as read the story: "Here is the Southwestern Desert." At the end of each line write how many syllables and the sentence has.**
1AM-F1. Sing/play a varied repertoire of songs from different genres and cultures.	**Listen to the tape "In the shade of the Saguaro" by Patty Horn. Choose one to sing along with a friend.**
1AM-F7. Improvise in consistent style, meter, and tonality. 1AM-F9. Create/arrange short songs and instrumental pieces with specified guidelines.	**Listen to the song "Down by the Bay." Change the lyrics to fist a desert scenario. Sing it and add your own background music and or rhythm.**
1AM-E8. Compose short pieces with specified guidelines.	**Create a musical play using creative characters from the desert. You may use finger puppets or any other creative characters. Try to explain why the desert environment is important to the world.**
1AM-F10. Listen to musical examples with sustained attention and self-discipline. 1AM-E8. Compose short pieces with specified guidelines.	**Some native tribes that live in the desert have specific dances that express their gratitude or feelings to nature. Create a song, poem or dance to express something that is important to you. Include music and rhythm to go with your products.**

Theme: Habitats
Topic: Deserts – how can we take care of the desert habitat by taking into account personal and communal ideas.
Generalization: A community is a place where personal feelings and traditions are valued. Every member of a community should strive to create a pleasant place to live by respecting each other. ("El respeto al derecho ajeno es la paz") "To respect the rights of others becomes peace." Benito Juarez
Literature focus:
Intelligence: Interpersonal and Intrapersonal

Arizona State Standards	Problem Types I-V
3SC-F3. **Describe and explain the interrelationship of populations, resources and environments.**	Type I: **In your group, discuss what are some important things that we need to conserve from the desert habitat.** * Think about what is the importance of the desert habitat.
4SC-F1. **Describe and explain cause and effect relationships in living systems.**	Type II: **Interview a friend about his or her favorite desert plant or desert animal. Plan your question before hand.** * Write a reflection on why do think the animals and plants in the desert need a camouflage? How does this help?
4SC-F1. **Describe and explain cause and effect relationships in living systems.** 4SC-F7. Explain the interaction of living and non-living components.	Type III: **Within your team, discuss why is each plant or animal important to the desert habitat. If you were to travel to a desert habitat, which desert would you choose? Why?** What are the ten most important items that you would take with you and why?
3SC-F3. **Describe and explain cause the interrelationship of populations, resources and environments.** **4SC-F7.** Explain the interaction of living and non-living components.	Type IV: **Discuss how could we create a desert habitat for our class. What are some things that would be needed? How can we ensure their survival? What types of foods would we need?** * You want to create a desert habitat in the classroom but you will need money to fund the project. To whom could you obtain the money? What would you write to say to them? What are you personal goals from this project?
1SC-F2. **Construct models that illustrate simple concepts and compare those models to what they represent.** **3SC-F3**. Describe and explain the interrelationship of populations, resources and environments. **4SC-F7.** Explain the interaction of living and non-living components.	Type V: **Make a model to present your habitat to the class. Remember to explain the importance of every detail that you are putting in.** * **Create something original to portrait your ideas of the importance of the desert habitat. Make sure to answer the question:** Why do we need a desert habitat?

Appendix G:
Teaching Unit for Middle School Students Based on the DISCOVER Curriculum Model

UNITED STATES HISTORY UNIT

For Students in Grades 5 to 8

By

Lou McCord

2001

CONTENTS

Unit set-up

Problems by Content Area

- Growth of the Nation
- Native Americans
- Equal Rights
- Age of Exploration
- Colonization
- Wars

Problems in Intelligences aligned with Arizona Standards:

- Bodily-Kinesthetic
- Naturalist
- Personal
- Musical
- Linguistic
- Spiritual
- Logical/mathematical
- Spatial

UNIT SETUP

Overview

U.S. History Problems to be used in conjunction with Social Studies lessons in Grades 5-8 in a gifted or accelerated class. The students will do problem types of their choice from the sections during the weeks that the sections are being taught and studied. Each section will be studied for different time lengths, therefore some sections have more problems than other sections. Some problems will be given as a choice in several sections. For example, Growth of the Nation can be used with early settlers. Westward expansion, and /or current issues as the United States expands. It will be more effective and enjoyable for the students to work on the problems during class time so some time will be set aside for the students to work on the problems in class or other times during the day when the teacher is available. This will also allow for group work if the students feel they want to work on the problems as a group project. Some problems will require students to take responsibility for work to be done outside of class time.

THEME:

Conflict

UNIT SECTIONS:

Age of Exploration
Colonization
Wars
Growth of the Nation
Equal Rights
Native Americans

MATERIALS:

U.S. History Textbook
World and U.S. maps
Areas maps of the U.S.
Research materials, such as the Internet, encyclopedia, dictionaries
Various American History novels
Arts/crafts supplies (poster board, markers, rulers, paints, boxes, etc.)

GRADING:

Grading will be based on a Rubric with scores decided by teachers and students prior to assignments. Points will be given according to the problem type done by the student. The problems are worth the number of points accorded to the problem type. For example, a Type V problem is assigned 5 points, Type IV is assigned 4 points, etc.

PROBLEMS

GROWTH OF THE NATION

Problems/Intelligence

Type I/Personal – There were many conflicts between the Native Americans and the settlers during the 1800's. What were the most serious? Why? What are some lasting effects that can be seen today? How would you have solved the conflicts and made life better for both sides?

Type I/Naturalist – When the American settlers began moving west they had many new and different experiences. They saw new lands, animals, people, and plants. What are some conflicts or problems they may have had when they came into contact with the different plants and animals?

Type I/Spiritual – memorize the Books of the Bible, Koran, Bahagvad Gita, etc. What are the differences?

Type III/Spiritual – Compare and contrast the philosophies of two spiritual leaders from different religions. How might these different philosophies lead to conflicts between the leaders of their followers?

Type III/Naturalist – Construct a terrarium of how you think a habitant of any area in the United States may have looked prior to being developed into a big city or community. Use any items in your terrarium that may be found in nature. You may use real items or draw/make them if necessary. What are some arguments that developers and environmentalists may have when land is wanted or needed for humans?

Type IV/Naturalist – Identify a problem that plants and animals have when large areas of land are cleared away and replaced with housing developments, malls, stores, etc. Suggest a solution that will satisfy developers, yet will not interrupt the lives of wildlife.

Type IV/Spiritual – At the end of Revelations, Jesus promised to come again. What might the Second Coming be like, including good and bad experiences or conflicts?

Type IV/Musical – Create an original musical instrument that uses a variety of music making methods. For example, your instrument could strum, bow, strike, etc. You may use any materials that you would like except musical instruments or part of musical instruments. Get together in a group to form a band whose instruments will create a song that express ideas about conflict.

Type IV/Personal – In a group setting, choose to be one character that is sitting in a town meeting. Be sure each group member chooses different personality characteristics from each other and from their own. Decide on a conflict that the group must resolve. Which

character are you most like now? Which would you like to be most like and what change would you have to make to be more like that person?

Type V/Personal – A small town which is represented by several different ethnic groups has raised money to build a statue to honor one person. How could the conflicts which will arise from the different groups be compromised? Write or draw your process for resolving inner conflicts.

Type V/Naturalist – Pretend you have just been given the job of exploring a new area of the United States uninhabited by humans. Create something (story, poem, picture, journal, dance, drawing) that will convince the government to leave the land as it is.

Type V/Linguistic – Read any novel that has conflict as a theme. Prepare a presentation to the class in some way using words. Some suggestions are: a play, song, essay, letter to the editor, monologue, children's book or debate.

Type V/Spiritual – Describe God, the Creator, Allah, or any other Supreme Being of your choice or belief.

Type V/Musical – Compose a musical piece with your choice of instrument that expresses your view of problems caused for American Indians by settlers.

NATIVE AMERICANS

Problems/Intelligence

Type I/personal – There were many conflicts between the Native Americans and the settlers during the 1800's. What were the most serious? Why? What are some lasting effects that can be seen today? How would you have solved the conflicts and made life better for both sides?

Type I/Bodily-Kinesthetic – Demonstrate a Native American dance that was performed prior to the warriors going into battle.

Type II/Bodily-Kinesthetic – Design and teach to the class a competition that opposing cultures of ideas (Native Americans, European Settlers, Spanish Conquistadors, Explorers, Slaves, Plantation Owners, Women, Civil Rights Workers, etc.) could play that would take the place of violence or war.

Type II/Naturalist – Using words or by drawing a picture, explain some ways that Native Americans were able to survive harsh factors in the environment, including weather, animals, droughts, floods, etc.

Type III/Musical – Create an early American Indian beat that may have been used prior to a conflict with settlers. Discuss how the difference in music of people form the different cultures may have contributed to their conflicts.

Type III/Linguistic – Pretend you are an Iroquois in 1608. Tell about your experience with the French traders as they helped their allies, the Huron Indians, increase their fur trade.

Type V/Musical – Compose a musical piece with your choice of instrument that expresses your view of problems caused for American Indians by settlers.

EQUAL RIGHTS

Problems/Intelligence

Type II/Bodily-Kinesthetic – Design and teach to the class a competition that opposing cultures or ideas (Native Americans, European Settlers, Spanish Conquistadors, Explorers, Slaves, Plantation Owners, Women, Civil Rights Workers, etc.) could play that would take the place of violence or war.

Type III/Spiritual – Compare and contrast the philosophies of two spiritual leaders from different religions. How might these different philosophies lead to conflicts between the leaders of their followers?

Type III/Bodily-Kinesthetic – Use your body to create a non-verbal communication between Civil Rights demonstrators and those opposed to any kind of segregation or equal rights.

Type IV/Bodily-Kinesthetic – with a partner, choose a conflict from any part of American History and create and perform a lay that helps explain the reasons for the conflict.

Type IV/Logical/mathematical – Survey all students (same grade), asking them to choose what they felt has been the most significant conflict in U.S. History. Graph the results. You may make any type of graph that you feel is appropriate to you information. Interpret your graph and make a conclusion about the findings.

Type V/Logical/Mathematical – Create a math problem using data involving The Civil Rights Movement. Start with events that occurred immediately after the Civil War through events of the 1960's.

Type V/Linguistic – Read any novel that has conflict as a theme. Prepare a presentation to the class in some way using words. Some suggestions are: a play, poem, song, essay, letter to the editor, monologue, children's book, or debate.

AGE OF EXPLORATION

Problems/Intelligence

Type I/Spatial – Using a map of Europe, Asia, and Africa, draw several routes that the European traders used to get to China. Put in symbols of the conflicts that occurred on these routes.

Type I/Logical/Mathematical – Classify the following events into three categories: war, peace-keeping, conflict. The first Spanish arrive in North America, Marco Polo visits China, Hernando Cortez Conquered the Aztec empire, The pilgrims wrote the Mayflower Compact, Pope convinced Pueblo leaders to work together with the Apache to force the Spanish to leave, Colonists throw British tea into the Boston Harbor, British Parliament passes the Intolerable Acts, Susan B. Anthony voted in Rochester, New York in 1872.

Type II/Spiritual – Interpret the interactions between Moses and the Egyptian Pharaoh just prior to the Hebrew Exodus.

Type II/Spatial – Make a poster or diorama of how one of the ships used by Christopher Columbus and his crew may have looked. Add details that include supplies, bantering items, or anything else you think they have had on the ship. Note anything on the ship that was helpful during the conflict the sailors had with stormy weather.

Type II/Bodily-Kinesthetic – Design and teach to the class a competition that opposing cultures or ideas (Native Americans, European Settlers, Spanish Conquistadors, Explorers, Slaves, Plantation Owners, Women Civil Rights Workers, etc.) could play that would take the place of violence or war.

Type III/Personal – The United States recognizes Christopher Columbus and honors him on Columbus Day. Some groups do not agree that it should be a holiday. Who is another historical person who is honored? Identify some groups who may not agree with the honor and what their reasons are for disagreeing. What are some things you would like to be remembered or honored for?

Type V/Naturalist – Pretend you have just been given the job of exploring a new area of the United States uninhabited by humans. Create something (story, poem, picture journal, dance, drawing) that will convince the government to leave the land as it is.

Type V/Bodily-Kinesthetic – Use your body to interpret the experiences of the Lewis and Clark Expedition. Some examples would be to show elements of wonders, fear, panic, etc.

COLONIZATION

Type I/Logical/Mathematical – Classify the following events into three categories: war, peace-keeping, conflict. The first Spanish arrive in North America, Marco Polo visits China, Hernando Cortez conquered the Aztec empire. The Pilgrims wrote the Mayflower Compact, Pope convinced Pueblo leaders to work together with the Apache to force the Spanish to leave, Colonists throw British tea into the Boston harbor, British Parliament passes the Intolerable Acts, Susan B. Anthony voted in Rochester, New York in 1872.

Type III/Naturalist – Construct s terrarium of how you think a habitat of any area in the United States may have looked prior to being developed into a big city or community. Use any items in your terrarium that may be found in nature. You may use real items or draw/make them if necessary. What are some arguments that developers and environmentalists may have when land is wanted or needed for humans?

Type III/Musical – Create an early American Indian beat that may have been used prior to a conflict with settlers. Discuss how the difference in music of people from the different cultures may have contributed to their conflicts.

Type IV/Personal – In a group setting, choose to be one character that is sitting in a town meeting. Be sure each group member chooses different personality characteristics from each other and from their own. Decide on a conflict the group must resolve. Which character are you most like now? Which would you like to be most like and what changes would you have to make to be more like that person?

Type V/Personal – A small town which is represented by several different ethnic groups has raised money to build a statue to honor one person. How could the conflict which will arise from the different groups be compromised? Write or draw your process for resolving inner conflicts.

Type V/Musical – Compose a musical piece with you choice of instrument that expresses your view of problems caused for American Indians by American settlers.

WARS

Type I/Linguistic – Identify 5 battles during the Civil War, where the battles took place, and the opponents from each side.

Type I/Bodily-Kinesthetic – Demonstrate a Native American dance that was performed prior to the warriors going into battle.

Type I/Musical – Find a song or recording written during/about the American Revolution and share it with the class.

Type II/Linguistic – Using a dictionary, find the following vocabulary words and write an accurate definition that relates to our studies of the Revolutionary war for each one.

Treaty	mercenary
Militia	traitor
Rebel	rebellion
Treason	patriot
Boycott	loyalist

Type II/Bodily-Kinesthetic – Design and teach to the class a competition that opposing cultures or ideas (Native Americans, European Settlers, Spanish Conquistadors,

Explorers, Slaves, Plantation Owners, Women Civil Rights Workers, etc.) could play that would take the place of violence or war.

Type II/Musical – Play a musical piece called *When Johnny Come Marching Home* by Roy Harris. When you hear the conflict of the war being expressed, play the song in a different key and/or accompaniment key.

Type II/Logical/Mathematical – Investigate the number of American (Confederate and Union) soldiers who died during the Civil War and number of soldiers who died during World War II. What do these results tell about the wars? What are the similarities? Differences?

Type II/Personal – Identify the leadership characteristics in Abraham Lincoln. Why did some people reject his position as leader? What did Lincoln do to try to solve or avoid conflicts during his Presidency? What qualities of this leadership do you recognize in yourself?

Type III/Logical/Mathematical – Compare the living space of Privates and Officers on a U.S. Battleship. What could be the cause of the differences? What are possible results of these differences?

Type III/Spatial – Make a diagram of the advantages and disadvantages of the North and the South just prior to the Civil War. Devise a visual model of a strategy that might have helped both sides make compromised that would have prevented the war.

Type IV/Linguistic – Write a short story about one Civil War hero. Your story must be based on fact. Include why the hero became involved in the war, the hero's view of the purpose of the war, and the feelings of the hero.

Type IV/Bodily-Kinesthetic – With a partner, choose a conflict from any part of American History and create and perform a play that helps explain the reasons for the conflict.

Type IV/Spatial – Visit or research a Revolutionary War Cemetery. Take notes from the headstones of any section. Make a visual chart of the information and show your conclusion about the information in some visual form.

Type IV/Logical/Mathematical – Survey all (same grade level) students, asking them to choose what they feel has been the most significant conflict in U.S. History. Graph the results. You may make any type of graph that you feel is appropriate to your information. Interpret your graph and make a conclusion about the findings.

Type V/Linguistic – Read any novel that has conflict as a theme. Prepare a presentation to the class in some way using words. Some suggestions are: a play, poem, song, essay, letter to the editor, monologue, children's book, or debate.

Type V/Spatial – Draw, design, or make a 3-D model of any MODERN instrument/tool that would have given the colonist an advantage over Great Britain during the Revolutionary War.

Problems Aligned with State Standards

Intelligence: Bodily-Kinesthetic Theme: Conflict

STANDARDS	PROBLEMS
ISS-E20/PO5 Describe aims and impact of western expansion and settlement with emphasis on American Indian nations. 2AD-E1/PO3 Select and demonstrate dances from various cultures and identify the functions and meanings of the dances to the culture.	Type I Demonstrate a Native American Dance that was performed prior to the warriors going into battle.
PA5-E3/PO2 Cooperate with a group to achieve group goals in competitive as well as cooperative settings and resolve interpersonal conflicts with sensitivity to rights and feelings of each other	Type II Design and teach to the class a competition that opposing cultures or ideas (Native Americans, European Settlers, Spanish Conquistadors, Explorers, Slaves, Plantation Owners, Women, Civil Rights Workers, etc.) could play that would take the place of violence or war.
2SS-E8/PO3 Explain the obligations and responsibilities of citizenship, with emphasis on Martin Luther King, Jr.'s "I Have a Dream" speech. 3AD-E1/PO2 Execute and recognize dance movements which express ideas, feelings, and moods.	Type III Use your body to create a non-verbal communication between Civil Rights demonstrators and those opposed to say kind of segregation or equal rights.
JAT-E1/PO1 Create and script scenarios that develop tension and suspense with several scenes including subplots and major and minor conflicts.	Type IV With a partner, choose a conflict from any part of American History and create and perform a play that helps explain the reasons for the conflict.
ISS-E20/PO2 Describe the aims and impact of the western expansion and settlement and how geography and economic incentives influenced early American explorations, including those of Lewis and Clark. 3AD-E1/PO2 Execute and recognize dance movements which express ideas, feelings, and moods.	Type V Use your body to interpret the experiences of the Lewis and Clark Expedition. Some examples would be to show elements of wonder, fear, panic, etc.

Intelligence: Naturalist Theme: Conflict

STANDARDS	PROBLEMS
4SC-F4/PO1 Identify adaptations of plants that allow them to live in specific environments. PO2 Identify adaptations of animals that allow them to live in specific environments.	Type I When the American settlers began moving west they had many new and different experiences. They saw new lands, animals, people, and plants. What are some conflicts or problems they may have had when they came into contact with the different plants and animals?
3SS-F2/PO1 Identify natural and human characteristics of places and how people interact with and modify their environment, with emphasis on natural characteristics of places, including land forms, bodies of water, natural resources, and weather. PO4 Identify natural and human characteristics of places and how people depend on the physical environment and its natural resources to satisfy their basic needs.	Type II Using words or by drawing a picture, explain some ways that Native Americans were able to survive harsh factors in the environment, including weather, animals, droughts, floods, etc.
4SC-F7/PO1 Identify living components within ecosystems. PO2 Identify non-living components within ecosystems. PO3 Describe the interaction among living and non-living components in an ecosystem.	Type III Construct a terrarium of how you think a habitat of any area in the United States may have looked prior to being developed into a big city or community. Use any items in your terrarium that may be found in nature. You may use real items or draw/make them if necessary. What are some arguments that developers and environmentalists may have when land is wanted or needed for humans?
4SC-F7/PO3 Describe the interaction among lining and non-living components in an ecosystem. 3SC-E4/PO1 Implement and apply a proposed solution or design a solution to a problem. 3SS-F2/PO6 Identify natural and human characteristics of places and how people interact with and modify their environment and the ways in which people have used and modified resources in the local regions, including dam construction, building roads, building cities, and raising crops.	Type IV Identify a problem that plants and animals have when large areas of land are cleared away and replaced with housing developments, malls, stores, etc. Suggest a solution that will satisfy developers, yet will not interrupt the lives of wildlife.
3SS-F2 Identify natural characteristics of places, including land forms, bodies of water, natural resources and weather.	Type V Pretend you have just been given the job of exploring a new area of the United States uninhabited by humans. Create something (story, poem, picture, journal, dance drawing) that will convince the government to leave the land as it is.

Intelligence: Interpersonal/Intrapersonal Theme: Conflict

STANDARDS	PROBLEMS
ISS-E6/PO5 Describe interactions between American Indians and settlers, including agricultural and cultural exchanges and alliances and conflicts. ISS-E20/PO5 Describe Western expansion and settlement of the United States, with emphasis on impact on the American Indian nations, including broken treaties and Long Walk of the Navajos.	Type I Inter – There were many conflicts between the Native Americans and the settlers during the 1800's. What were the most serious? Why? What are some lasting effects that can be seen today? Intra – How would you have solved the conflicts and made life better for both sides?
ISS-E21/PO4 Explain how sectionalism caused the Civil War, with emphasis on the emergence of Abraham Lincoln as national figure. ISS-E21/PO5 Explain how sectionalism caused the Civil War, with emphasis on the presidential election of 1860, Lincoln's victory, and the South's secession. ISS/E22/PO1 Explain the course and consequences of the Civil War and how it divided the American people, with emphasis on contributions and significance of key individuals, including Abraham Lincoln. ISS-E23/PO! Analyze the character and lasting consequences of Reconstruction, with emphasis on Lincoln's plans for reconstruction of the south.	Type II Inter – Identify the leadership characteristics in Abraham Lincoln. Why did some people reject his position as leader? What did Lincoln do to try to solve or avoid conflicts during his Presidency? Intra – What qualities of this leadership do you recognize in yourself?
ISS-E5/PO2 Describe the causes, course, and consequences of early European exploration of North America, with emphasis on the characteristics and results of Christopher Columbus.	Type III Inter – The United States recognizes Christopher Columbus and honors him on Columbus Day. Some groups do not agree that it should be a holiday. Who is another historical person who is honored? Identify. Some groups who may not agree with the honor and what their reasons are for disagreeing Intra – What are some things you would like to be remembered or honored for?
2SS-E5/PO1 Identify and describe a citizen's fundamental constitutional rights, with emphasis on freedom of religion, expression, assembly, and press.	Type IV Inter – In a group setting, choose to be one character that is sitting in a town meeting. Be sure each group member chooses different personality characteristics from each other and from their own. Decide on a conflict that the group must resolve. Intra – Which character are you most like now? Which would you like to be most like and what changes would you have to make to be more like that person?
3SS-E6/PO1 Describe the economic, political, cultural, and social processes that interact to shape patterns of human populations, interdependence, and cooperation and conflict contribute to political, economic, and social divisions.	Type V Inter – A small town which is represented by several different ethnic groups has raised money to build a statue to honor on person. How could the conflicts which will arise from the different groups be compromised? Intra – Write or draw your process for resolving inner conflicts?

Intelligence: Linguistic Theme: Conflict

ARIZONA STANDARDS	PROBLEMS
ISS-E22/PO3 Explain the course and consequence of the Civil War and how it divided American people, with emphasis on the major turning point of the Civil War, including Gettysburg.	Type I Identify 5 battles during the Civil War, where the battles took place, and the opponents from each side.
ISS- E7/PO1 Describe the causes and consequences of the American Revolution, with emphasis on the causes. ISS-E7/PO2 Describe the causes and major turning points in the Revolutionary War.	Type II Using a dictionary, find the following vocabulary words and write and accurate definition that relates to our studies of the Revolutionary war for each one. Treaty mercenary Militia traitor Rebel rebellion Treason patriot Boycott loyalist
ISS-E6/PO5 Describe the political, religious, and economic aspects of North American colonization, with emphasis on interactions between American Indians and European settlers, including reasons for alliances and results of conflicts. STANDARD 3 ESSETIALS Prepare and deliver an organized speech and effectively convey the message through verbal and nonverbal communications.	Type III Pretend you are an Iroquois in 1608. Tell about your experience with the French traders as they helped their allies, the Huron Indians, increase their fur trade.
ISS-E22/PO2 Explain the course and consequences of the Civil War and how it divided the American people, with emphasis on contributions and significance of key individuals, such as Abraham Lincoln, Robert E. Lee, William Tecumseh Sherman, or Ulysses S. Grant. ISS-E22/PO4 Explain the course and consequences of the Civil war with emphasis on the role of African-Americans in the Civil War.	Type IV Write a short story about one Civil War hero. Your story must be based on fact. Include why the hero became involved in the war, the hero's view of the purpose of the war, and the feeling of the hero.
R-E3/PO5 Analyze selections of fiction by identifying the plot line (i.e., conflict), identify the theme. W-E4/PO1 Write an expository essay that begins by stating the thesis. W-E6/PO1 Write formal communications, such as personal or business letters, messages, directions, and applications.	Type V Read any novel that has conflict as a theme. Prepare a presentation to the class in some way using words. Some suggestions are: a play, poem, song, essay, letter to the editor, monologue, children's book, or debate.

Intelligence: Spiritual Theme: Conflict

ARIZONA STANDARDS	PROBLEMS
ESSENTIALS Prepare and deliver an organized speech	Type I Memorize the Books of the Bible, Koran, Bahagvad Gita, etc. What are the differences?
R-E2/PO1 Identify the main ideas; critical and supporting details; and the author's purpose, feelings and point of view of the text /PO3 Summarize the text in own words. /PO6 Summarize the text in chronological, sequential or logical order.	Type II Interpret the interactions between Moses and the Egyptian Pharaoh just prior to the Hebrew Exodus.
R-E6/PO2 compare the lives and experiences of characters in history to present-day individuals who have similar goals or face similar challenges ISS-E11/PO2 Describe the major religions, including Hinduism, Buddhism, Judaism, Christianity, and Islam, with emphasis on the founding leaders and their teachings.	Type III Compare and contract the philosophies of two spiritual leaders from different religions. How might these different philosophies lead to conflicts between the leaders or their followers?
R-E2/PO7 Use reading strategies such as making inferences and predictions, summarizing, paraphrasing, differentiating fact from opinion, drawing conclusions, and determining the author's purpose and perspective to comprehend written selections.	Type IV At the end of Revelations, Jesus promises to come again. What might the Second Coming be like, including good and bad experiences or conflicts?
W-E3/PO3 Use personal interpretations, analysis, evaluations, or reflections to evidence understanding of subject.	Type V Describe God, the Creator, Allah, or any other Supreme Being of you choice or belief.

Intelligence: Logical-Mathematical Theme: Conflict

ARIZONA STANDARDS	PROBLEMS
IM-E1/PO3 Read and write whole numbers using real-world situations. 2SS-F3/PO1 Describe the rights and responsibilities of citizenship, with emphasis on the elements of fair play and good sportsmanship.	Type I Classify the following events into three categories: war, conflict, peace-keeping. The first Spanish arrive in North America, Marco Polo visits China, Hernando Cortez conquered the Aztec empire, The Pilgrims wrote the Mayflower Compact, Pope convinced Pueblo leaders to work together with the Apache to force the Spanish to leave, Colonists throw British tea into the Boston Harbor, British Parliament passes the Intolerable Acts, Susan B. Anthony voted in Rochester, New York in 1872.
2M-E2/PO2 Interpret and analyze data.	Type II Investigate the number of American (confederate and union) soldiers who died during the Civil War and the number of soldiers who died during World War II. What do these results tell about the wars? What are the similarities? Differences?
5M-E4 Develop and use formulas and procedures to solve problems involving measurement.	Type III Compare the living space of Privates and Officers on a U.S. Battleship. What could be the cause of the differences? What are possible results of these differences?
2M-E1/PO3 Choose an appropriate graphical format to organize and represent data. 2M-E2/PO2 Interpret and analyze data.	Type IV Survey all fifth grade students, asking them to choose what they feel has been the most significant conflict in U.S. History. Graph the results. You may make any type of graph that you feel is appropriate to your information. Interpret your graph and make a conclusion about the findings.
Standard 2 Students use data collection and analysis, statistics, and probability to make valid inferences, decisions, and arguments and to solve a variety of real-world problems.	Type V Create a math problem using data involving the Civil Rights Movement. Start with events that occurred immediately after the Civil War through events of the 1960's.

Intelligence: Spatial Theme: Conflict

STANDARDS	PROBLEMS
ISS-E5/PO1 Describe causes, course, and consequences of early European exploration with emphasis on the reasons for European exploration of the Americas. ISS-P1/PO3 Use a variety of maps to interpret human movement and the diffusion of ideas, technological innovations, and goods.	Type I Using a map of Europe, Asia, and Africa, draw several routes that the European traders used to get to China. Put in symbols of the conflicts that occurred on these routes.
ISS-E15/PO1, PO2 Analyze origins, obstacles, and impacts of the Age of Exploration with emphasis on improvements in technology, including the compass and work of Prince Henry and the voyages of Columbus to the New World and the subsequent searches for the Northwest passage.	Type II Make a poster or diorama of how one of the ships used by Christopher Columbus and his crew may have looked. Add details that include supplies, bartering items, or anything else you think they have had on the ship. Note anything on the ship that was helpful during the conflict the sailors had with stormy weather.
ISS-E8/PO1, PO8 Demonstrate and apply the basic tools of historical research, constructing and interpreting graphs and charts using historical data and recognizing the difference between cause and effect and a mere sequence of historical events. ISS-E22/PO1, PO2, PO3, PO6 Explain the course and consequences of the Civil War, including impact of American fighting Americans, high casualties caused by disease and the type of warfare and widespread destruction of American property; contributions and significance of key individuals, including Abraham Lincoln, Robert E. Lee, William Tecumseh Sherman, and Ulysses S. Grant; the major turning point so the Civil War; the strategic importance of the Southwest.	Type III Make a diagram of the advantages and disadvantages of the North and the South just prior to the Civil War. Devise a visual model of a strategy that might have helped both sides make compromises that would have prevented the war.
ISS-E8/PO1, PO3 Demonstrate and apply the basic tools of historical research, and analyze and evaluate historical materials, constructions and interpreting graphs and charts using historical data and framing questions that can be answered by historical study and research. ISS-E1/PO3 Interpret historical data in the form of simple graphs and tables.	Type IV Visit or research a Revolutionary War Cemetery. Take notes from the headstones of any section. Make a visual chart of the information and show your conclusion about the information in some visual form.
ISS-E1/PO2 Describe the causes, key individuals, and consequences of the American Revolution, with emphasis on major turning points in the Revolutionary War and the importance of aid from France. ISS-P2 Demonstrate knowledge of research sources and apply appropriate research methods, including framing open-ended questions, gathering pertinent information, and evaluating the evidence and point of view contained within primary and secondary sources.	Type V Draw, design, or make a 3-D model of any MODERN instrument/tool that would have given the colonist an advantage over Great Britain during the Revolutionary War.

Intelligence: Musical Theme: Conflict

ARIZONA STANDARDS	PROBLEMS
2SS-F2/PO1 Identify and describe the symbols, icons, songs, and traditions of the United States that exemplify cherished ideas and provide continuity and sense of community across time, with emphasis on the Pledge of Allegiance and the songs that express American ideas, including the National Anthem and America the Beautiful.	Type I Find a song or recording written during/about the American Revolution and share it with the class.
1AM-E7-PO2 Improvise and play harmonic accompaniment using tonic and dominant chords	Type II Play a musical piece called *When Johnny Comes Marching Home* by Roy Harris. When you hear the conflict of the war being expressed, play the song in a different key and/or accompaniment key.
2AM-E1/PO1 Describe characteristics or various musical genres and cultures 1SS-E6/PO5 Describe the political, religious, and economic aspects of North American colonization, with emphasis on interactions between American Indians and European settlers, including agricultural and culture exchange and alliances and reasons for, and the results of, the conflicts.	Type III Create an early American Indian beat that may have been used prior to a conflict with settlers. Discuss how the differences in music of people from the different cultures may have contributed to their conflicts.
1AM-E10 Use a variety of nontraditional sound sources and electronic media when composing an arranging.	Type IV Create an original musical instrument that uses a variety of music making methods. For example, your instrument could strum, blow, strike, etc. You may use any materials that you would like except musical instruments or parts of musical instruments. Get together in a group to form a band whose instruments will create a song that expresses ideas about conflict.
3AM-E2/PO1 Describe elements of subject matter in other disciplines.	Type V Compose a musical piece with your choice of instrument that expresses your view of problems causes for American Indians by American settlers.

Appendix H:
Teaching Unit for High School Students Based on the DISCOVER Curriculum Model

Teaching Unit for High School English

By Suzanne Hall

Topic: Romeo and Juliet

Theme: Universality of Human Experience

Spring, 2001

Unit: Romeo and Juliet

Theme: Universality of human experience

Generalization: Throughout history and across all cultures there are experiences common to us all. By studying a series of experiences familiar to the student, but in a different historical or cultural context, the student will be able to further understand his/her personal situation as well as their inner-connectedness with the rest of humanity.

Overview: This unit will be completed in 8 weeks. Through a variety of activities students will explore topics such as passion, forgiveness, hate/love duality, classical writers, play writing, poetry, generation gaps, societal expectations, oratory skills, power of word choice, perceived and real conflict, and so on.

Outline:

I. Introduction to Shakespeare and Elizabethan England
*This week will be largely spent on tedious note-taking and lecture style classes.
II. Act I
III. Act II
IV. Act III
V. Act IV
VI. Act V
VII. *Each of the above acts will take 1 week. During that time we will be reading large selections of the play together in class. We will be supporting our understanding of the text through super cool activities that are evolving in the problem matrices. Because of the complexity of Shakespeare's language and the issues in the play we will have to spend some time reading as homework. I do not prefer this method for a play – but by the fourth quarter we are pretty strapped for time. Ideally we would spend about 2 weeks on each act and 2 weeks on the 1996 movie. But I will never have 16 weeks total to spend on one piece of literature. Ugh!
VIII. Activities presentations. Students will use this week to present their activities to their classmates. Of the ten they will have completed, I will ask them to present two to four for the class.
IX. *William Shakespeare's Romeo and Juliet*, the movie
*We have the final this week as well. However, the movie is a stunning opportunity for some analysis on the part of the students. We are able to do some pretty intense work figuring out what the director was trying to say with a variety of images and soundtrack choices. This is an opportunity for the students to clump all of the previous weeks' work into an articulate discussion of a contemporary interpretation.

Description of Students: My students are freshmen in a T.U.S.D. high school G.A.T.E block program. In the other half of their block, Humanities, they will be studying the art, architecture, and philosophy of the Renaissance. Jolene will be supporting our study of the universal human experience by exploring universal elements of art (and the aesthetic

values of the Renaissance). Many students will have a general familiarity with Shakespeare due to a large number of recent movies including *Elizabeth*, *Shakespeare in Love*, *William Shakespeare's Romeo and Juliet*, and a plethora of other contemporary films interpreting his plays. However, most will not have a strong knowledge of Elizabethan England, Renaissance Europe and Shakespeare (in more depth than popular culture presents in 90 minutes of film!!). Furthermore, several of my students will have already read this play in eighth grade G.A.T.E. There are approximately 30 students in each period. Although the groups are predominantly White, there is a strongly voiced representation of other cultures in each period. Students are seated in groups of three according to my seating chart. When we work in small groups, students are typically encouraged to select their own partners. Students are given a variety of learning situations each week to provide an opportunity for their different learning styles to dominate.

Management Plan: The students will be presented with a variety of opportunities to use their various intelligences. I am not teaching each set of problems as attached to a specific intelligence. Rather, the students will be given all of the problems that connect in some way to Act I (and then the same procedure with each following act. . .). I will be explaining the types of problems. From the explanation of problem types and the presentation of the choices, students will be required to select two problems to complete per act. They will need to reflect a range in the type selection. By the end of the five acts everyone is required to have completed every type of problem at least once. My main intentions in this approach are to encourage development of metacognitive skills while still providing student choice. I strongly feel that one of the most critical tasks I have as a teacher of the gifted is to put my students in situations where they must become accountable for knowing themselves as learners and thinkers. At this point in the year (Romeo and Juliet is always the last text I teach for freshmen) I expect students to be able to challenge themselves in known areas of weakness, celebrate their strengths through outstanding products in more comfortable intelligences, and reflect on their choices and experiences as learners.

Outline of Weekly Plans:
Key to reading the outline: **A** = The assignment for the week. **P** = The procedure we will follow for the week. **AC** = The activities the students will do to support the assignment.

Week One	Week Two	Week Three	Week Four
A: Students will read introductory comments in the selected version of Romeo and Juliet, Shakespeare, and Elizabethan England.	**A:** Read Act I in class. Complete two activities related to Act I by the following Monday.	**A:** Read Act II. You are responsible for reading the entire act by the end of the week. We will begin the act together on Monday and finish it on Friday.	**A:** Quiz on introduction, Act I and Act II. Read Act III. We will only be reading on Wednesday together in class.
P: Notes will be given on overhead. We will also discuss students' prior knowledge of the topics. At this time we will also review multiple intelligences work we did in Sept. We will also discuss problem types.	**P:** We will read in parts. The reading out loud will take the entire week. As this is new to us, we will stop at the end of each scene for notes and clarification. Notes will be a combination of overhead, lecture, and small group work.	**P:** Students will be given class time each day to work on activities from the previous week and to work on this week's activities. Our in class reading will reflect the shared class periods. I anticipate us reading two of the five scenes together in class.	**P:** Students will have a terrible short answer quiz to reflect their understanding of the play thus far. After the quiz we will have time for the previous week's activities and some in class reading. Friday will be an entire class for activity work.
AC: Reflect on all of the ways Shakespeare is still present in our culture. Explain, in any form, why we need to study this very old piece of literature.	**AC:** Select two tasks from the list in your activity packet. Note which intelligences you are working out of. Note which problem type you are completing. At the end of each activity be sure to complete the "Reflections" handout.	**AC:** Select two tasks from the list in your activity packet. Note which intelligences you are working out of. Note which problem type you are completing. At the end of each activity be sure to complete the "Reflections" handout.	**AC:** Select two tasks from the list in your activity packet. Note which intelligences you are working out of. Note which problem type you are completing. At the end of each activity be sure to complete the "Reflections" handout.

Key to reading the outline: **A** = The assignment for the week. **P** = The procedure we will follow for the week. **AC** = The activities the students will do to support the assignment.

Week Five	**Week Six**	**Week Seven**	**Week Eight**
A: Monday is a work day on activities. Begin reading Act IV at home. We will start with scene iii in class on Wednesday. Act IV needs to be completely read for class Monday.	**A:** Quiz over Acts III and IV. Read Act V in class on Monday and Wednesday. Work on projects individually at home. Begin project presentations on Friday.	**A:** Project presentations are all this week. Students should look at the activities they completed for each of the acts (a total of ten) and select 2-4 to discuss and present to class.	**A:** Watch *William Shakespeare's Romeo and Juliet* in class. Discuss imagery, music, scenery, etc. in small group and whole class. Final exam is on Friday of this week.
P: We will read in parts on Wednesday. Students will have time in class to work on activities on Monday.	**P:** Monday and Wednesday will be spent entirely on reading in class and getting notes. Students will begin the class-wide presentation of their projects on Friday.	**P:** Student presentations will run all week.	**P:** Class discussions will take place after the movie on Monday. Students will initially be in small groups and then move to whole class discussion. I will present focus questions for the small group discussions.
AC: Select two tasks from the list in your activity packet. Note which intelligences you are working out of. Note which problem type you are completing. At the end of each activity be sure to complete the "Reflections" handout.	**AC:** Select two tasks from the list in your activity packet. Note which intelligences you are working out of. Note which problem type you are completing. At the end of each activity be sure to complete the "Reflections" handout.	**AC:** Select two to four activities you have worked on during this play. Present them to class and be prepared to discuss why you chose those activities, how you worked on them, what was easy/difficult, etc. (Sort of a summary of the "Reflections" handout.)	**AC:** Small group discussion of movie and final exam study groups will consume this week.

REFLECTIONS

Answer the following questions regarding the activity you have just completed. The primary purpose of this handout is to provide you space in which you can reflect on what you have just done. However, you need to remember that this paper is also graded (For effort! There are no "right" answers here.). I do expect you to thoughtfully complete this form to help me (and more importantly, to help YOU!) get a picture of you as a thinker and a learner.

Intelligence: **Problem Type:**

Problem Description:

Product Description:

1. Why did you select this activity?

2. What was difficult for you in this project?

3. What was easy?

4. What steps did you go through mentally in planning your end product?

5. How was the end product different from what you initially imagined?

6. Explain the difference between the initial plan and the finished project.

7. How would you "fix" this product if you had more time or materials?

8. What emotion or feelings do you want to evoke in your audience?

9. How did this activity further your understanding of *Romeo and Juliet*?

10. Use what you know about multiple intelligences to analyze which of your intelligences you relied on to complete this activity.

ACTIVITIES LIST

For each act in *Romeo and Juliet* you will need to select two activities to complete. Of the 10 total activities you are completing, you MUST have done one of each problem type (there are 5 total) and tried at least five intelligences out. Your activities are incomplete if I do not see the aforementioned variety.

Below you will find a listing of the available activities. They are broken down by act. However, there are several activities that can be used throughout the play. Those are listed after Act V. If you have an idea for an activity you would like to do, try to classify it by intelligence and problem type and then see me during conference period to get it approved. (If you can not classify it, you and I will do that together.) Any activity not pre-approved by me will not be accepted for credit.

ACT ONE

Musical, Type 4: Listen to the recordings of Act I, scene i. We are hearing 5 different actors from different eras in theatre. Note how dramatically their reads change your emotional response. Select a passage to read in a variety of manners. You need to convey relevant emotions – but have completely different reads. You can work in small groups and have different people do the different reads if you would like. Be conscious of tone and voice.

Linguistic, Type 1: For the following vocabulary words you will need to find a definition, indicate the part of speech, and use the word in a sentence. Prose Verse Elizabethan Soliloquy Sonnet Toil Strive Pernicious Covert Portentous.

Linguistic, Type 3: Analyze one of the following sets of lines. Write an analytical essay to explain Shakespeare's use of language to create both a comedic and tragic moment simultaneously. Translate the set of lines into contemporary English, maintaining the author's intent and his play with language.
Act I, i, 1-51; Act I, ii, 45-83; Act I, iv, 1-53.

Spatial, Type 1: Make a reproduction of Shakespeare's Globe theatre and the surrounding neighborhoods. Reflect social concerns of the time in your reproduction.

Spatial, Type 3: In Act I, scene i Shakespeare uses his characters' lines to connote the values of Elizabethan England. Select 4 to 6 lines and visually display the lines to portray the values.

Logical-Mathematical, Type 1: In the prologue of Act I, mark the stressed and unstressed syllables of the iambic pentameter in each line. Indicate the feet and appropriate stanza breaks (8-6 or 6-6-2). Please also indicate any hpermetric lines and provide a possible meter interpretation.

Logi-Mathe, Type 2: Prepare the prologue from Act I for oral presentation. Memorize and perform the sonnet with appropriate rhyme scheme and iambic stresses.

ACT TWO

Natural, Type 3: In act II, scene iii the Friar does his nature monologue. The gist of the speech is that in nature ugly growths can be beautiful in their ability to heal while beautiful plants can be deadly. Find an example of each of Friar Laurence's classifications. Do a sketch of the plants. Prepare a brief oral discussion of the plant, its traditional uses, and the toxin or healing components.

Musical, Type 1: Read Act II, scenes v and vi together in class. Produce the sounds that would have occurred as those scenes were performed.

Musical, Type 2: Use the provided musical selections to support Act II, scenes v and vi. You are essentially creating a soundtrack for these scenes. You must convey both the superficial and deeper feelings Shakespeare is working with. Create a tape (or burn a CD) with your work. Music selections include excerpts from Wagner, Gypsy Kings, Johnny Cash, and Duke Ellington.

Musical, Type 3: Write the lyrics to the love songs of Romeo or Juliet in Act II. You are creating the lyrics to reveal the characters of either Romeo or Juliet as a young person in love. Create an original melody that would accompany the songs.

Logi-Mathe, Type 2: Prepare either Prologue (from Act I or Act II) for oral presentation. (Both are sonnets). Memorize and perform the sonnet with appropriate rhyme scheme and iambic stresses.

Logi-Mathe, Type 3: Shakespeare has been very sly in some of his sonnet use by making a sonnet out of seemingly innocent dialogue or soliloquy. Analyze Acts II and III for hidden sonnets. When you find a sonnet, mark it according to iambic pentameter on your paper.

Linguistic, Type 3: Analyze one of the following sets of lines. Write an analytical essay to explain Shakespeare's use of language to create both a comedic and tragic moment simultaneously. Translate the set of lines into contemporary English, maintaining the author's intent and his play with language. Act II, v, 21-65.

ACT THREE

Interpersonal-Intrapersonal, Type 1: Identify the feelings Romeo and Tybalt are having as they meet each other immediately after the wedding. (Act III, scene i). In you journal write about how you handle conflict. How does our society encourage conflict resolution? How did you learn to deal with problems? Is there ever a time when violence is an appropriate solution?

Spatial, Type 2: Select an object and portray the disintegration of Romeo's mental state through each act. (Juliet's disintegration is also an option.) An example might be an apple in various states of decay – or perhaps a pair of jeans over time. . . .

Logi-Mathe, Type 3: Shakespeare has been very sly in some of his sonnet use by making a sonnet out of seemingly innocent dialogue or soliloquy. Analyze Acts II and III for hidden sonnets. When you find a sonnet, mark it on your paper according to iambic pentameter.

Body-Kinesthetic, Type 5: In a group of 3 or 4 students, you need to pantomime a scene from Act III, IV, or V. The rest of the class will try to figure out what you are portraying.

ACT FOUR

Spatial, Type 2: Select an object and portray the disintegration of Romeo's mental state through each act. (Juliet's disintegration is also an option.) An example might be an apple in various states of decay – or perhaps a pair of jeans over time. . . .

Bod-Kine, Type 3: Select two consecutive scenes from Act IV. With a partner block the scenes to reflect the suspense, tension, and contrast that Shakespeare is attempting.

Bod-Kine, Type 5: In a group of 3 or 4 students, you need to pantomime a scene from Act III, IV, or V. The rest of the class will try to figure out what you are portraying.

ACT FIVE

Spatial, Type 2: Select an object and portray the disintegration of Romeo's mental state through each act. (Juliet's disintegration is also an option.) An example might be an apple in various states of decay – or perhaps a pair of jeans over time. . . .

Bod-Kine, Type 4: In a group of three, select 3 base movements for this activity. These movements must be going on continuously as you perform a set of lines from Act V. As one actor switches from movement A to movement C, the other two actors must adjust. All three base movements must still go on simultaneously.

Bod-Kine, Type 5: In a group of 3 or 4 students, you need to pantomime a scene from Act III, IV, or V. The rest of the class will try to figure out what you are portraying.

ALL ACTS

The following problems are applicable to any act or scene in the play. They are categorized according to problem type to assist you in selecting a variety of problem types.

Type 1

Natural: Identify the images of the natural world Shakespeare uses. Make a list of these images.

Spiritual: Watch the 1996 movie *William Shakespeare's Romeo and Juliet*. List several specific examples of religious imagery the director uses. Be sure to indicate, with as much detail as possible, the point in the play at which the imagery is used.

Bod-Kine: Mimic a character from *William Shakespeare's Romeo and Juliet*. Recite the lines as you model facial expressions and body language.

Type 2

Natural: Create the life cycle of this play. Use biological stages and vocabulary. In some way depict this life style.

Inter-Intra: These pairs of characters are foils for each other: Nurse-Friar, Mercutio-Romeo, Benvolio-Tybalt. What personality extremes in each person balance or neutralize the other? Use specific lines from the characters to support your assertions. In your journal reflect on the roles you play in others' lives. Do you choose the role or is it put on you? What roles do you assign to people in your life? How do you think these roles are selected?

Spiritual: In small groups (teacher assigned) identify the universal elements or ideas that exist in contemporary religions with which you are familiar. Which of these universals appear in Romeo and Juliet? Convey your group ideas to the class.

Linguistic: Select on of Romeo and Juliet's conversations to perform with a partner. Prepare your oral interpretation considering the author's intent and poetic forms.

Bod-Kine: We are going to depict the entire play. One actor will begin with silent action. As s/he progresses in the story, you will take over. Signal with "freeze" when you are ready to step in where s/he left off. Let's try to incorporate as many students into the ongoing action as possible. The audience needs to be silent as we follow the devastation of passion.

Type 3

Inter-Intra: Analyze the dramatic personality of Lord Capulet in respect to his attitude toward and treatment of both Romeo and Juliet Reflect on a time when your parent(s) has done a seeming about face on a matter important to you. What could have cause the shift? How do you deal with it? What would you do differently if possible?

Spiritual: Research Elizabethan England or Renaissance Europe and their spiritual belief systems. Demonstrate how these various beliefs appear in Romeo and Juliet.

Type 4

Natural: Take a nature walk. On your walk find settings occurring naturally that could be symbolic of some aspect of Romeo and Juliet. Sketch your image and be prepared to present.

Inter-Intra: With a partner, role-play a therapy session with either Juliet, Romeo, Friar Laurence, Tybalt, or Nurse. Sculpt an image, emotion, or feeling you would most like to convey to another person. Why have you been unable to communicate thus far?

Linguistic: Write an additional scene to *Romeo and Juliet*. You may select the act and scenes it follows. Be attentive to literary conventions and maintaining fluency between your scene and the rest of the play. Your scene must contribute substantially to the play without violating the integrity of it.

Spiritual: Use you belief system to discuss/depict/comment on the actions of the principle players in this story.

Spatial: Demonstrate, through a diorama, Shakespeare's figurative language in a specific moment of *Romeo and Juliet*.

Logi-Mathe: Select a portion of dialogue between 2 characters. Translate the dialogue into a sonnet. The 14 lines will still be a dialogue. Be attentive to rhyme and meter requirements as well as dialect issues for Shakespeare's English.

Type 5

Natural: Convey a conflict in nature that somehow reflects the universal elements of conflict we have discussed with this play.

Musical: Use a variety of instruments to depict a moment from *Romeo and Juliet* (you should cover at least a scene). Your musical performance should convey the moment to us – without any words. This is a *Peter and the Wolf* sort of production!

Linguistic: Use any combination of literary elements seen in *Romeo and Juliet* in an original piece of writing. Elements may include: dramatic irony, simile, metaphor, sonnet, soliloquy, verse-prose, irony, alliteration, personification, punning, classical references, etc.

Spiritual: How does your spirituality shape your daily life in the contemporary United States? How did it shape the daily lives of Romeo and Juliet? Address these questions.

Spatial: Convey a universal element of human existence seen today and in *Romeo and Juliet*.

Logi-Mathe: Write a sonnet in contemporary English. You will need to be sensitive to natural stresses in order to fulfill the meter requirements of iambic pentameter while still preserving a natural evolution of the sonnet.

Inter-Intra: Participate in a panel discussion on one of the universal themes or values we have discussed throughout the play. A connection to the contemporary world needs to be made.
Who is a foil in your life? What does that say of you? What does it say of the foil? Convey or portray this pairing.

Problem Solving Activities by Intelligences and Arizona State Standards

Theme: Universality of Human Experience Unit: *Romeo and Juliet*
Intelligence: Naturalistic

Arizona State Standards	Problems
• Apply reading strategies such as extracting and summarizing, clarifying and interpreting information.	**Type I** Identify the images of the natural world Shakespeare uses. Make a list of these images.
• Demonstrate the ability to sequence, analyze, categorize, and describe ideas.	**Type II** Create the life cycle of this play. Use biological stages and vocabulary. In some way depict this life style.
• Craft a cohesive research document. • Conduct an interview, taking appropriate notes and summarizing the information learned.	**Type III** In Act II, scene iii the Friar does his nature monologue. The gist of the speech is that in nature ugly growths can be beautiful in their ability to heal while beautiful plants can be deadly. Find an example of each of Friar Laurence's classifications. Do a sketch of the plants. Prepare a brief oral discussion of the plant, its traditional uses, and the toxin or healing components. Or Identify plants used today either for medicines or poisons. Friar Laurence had a thorough knowledge of plant life and the connection to health. Who has that knowledge today? Are there cultural variations? Present your findings in some way.
• Analyze classic literature selections for the universality of themes such as the interaction between nature and man.	**Type IV** Take a nature walk. On your walk find settings occurring naturally that could be symbolic of some aspect of Romeo and Juliet. Sketch your image and be prepared to present.
• Analyze classic literature selections for the universality of themes such as the interaction between nature and man.	**Type V** Convey a conflict in nature that somehow reflects the universal elements of conflict we have discussed with this play.

Theme: Universality of Human Experiences Unit: *Romeo and Juliet*

Intelligence: Bodily Kinesthetic

Arizona State Standards	**Problems**
• Plan, organize, develop, produce, and evaluate an effective presentation. • Deliver oral interpretations of literary works.	**Type I** Mimic a character from *William Shakespeare's Romeo and Juliet*. Recite the lines as you model facial expressions and body language.
• Recognize an author's use of figurative language.	**Type II** We are going to depict the entire play. One actor will begin with silent action. As s/he progresses in the story, you will take over. Signal with "freeze" when you are ready to step in where s/he left off. Let's try to incorporate as many students into the ongoing action as possible. The audience needs to be silent as we follow the devastation of passion.
• Plan, organize, develop, produce, and evaluate an effective presentation.	**Type III** Select two consecutive scenes from Act IV. With a partner block the scenes to reflect the suspense, tension, and contrast that Shakespeare is attempting.
• Plan, organize, develop, produce, and evaluate an effective presentation. • Interpret use of figurative and literal language.	**Type IV** In a group of 3, select 3 base movements for this activity. These movements must be going on continuously as you perform a set of lines from Act V. As one actor switches from movement A to movement C, the other two actors must adjust. All three base movements must still go on simultaneously.
• Plan, organize, develop, produce, and evaluate an effective presentation.	**Type V** In a group of 3 or 4 students, you need to pantomime a scene from Act III, IV, or V. The rest of the class will try to figure out what you are portraying.

Theme: Universality of Human Experiences Unit: *Romeo and Juliet*

Intelligence: Interpersonal/Intrapersonal

Arizona State Standards	**Problems**
• Apply reading strategies such as extracting, interpreting, and extending the ideas presented.	**Type I** Identify the feelings Romeo and Tybalt are having as they meet each other immediately after the wedding. (Act III, scene i). In your journal write about how you handle conflict. How does our society encourage conflict resolution? How did you learn to deal with problems? Is there ever a time when violence is an appropriate solution?
• Analyze contemporary and classic literature for universality of themes such as interdependence.	**Type II** These pairs of characters are foils for each other: Nurse-Friar, Mercutio-Romeo, Benvolio-Tybalt. What personality extremes in each person balance or neutralize the other? Use specific lines from the characters to support your assertions. In your journal reflect on the roles you play in others' lives. Do you choose the role or is it put on you? What roles do you assign to people in your life? How do you think these roles are selected?
• Analyze world literature for the universality of themes.	**Type III** Analyze the dramatic personality of Lord Capulet in respect to his attitude toward and treatment of both Romeo and Juliet. Reflect on a time when your parent(s) has done a seeming about face on a matter important to you. What could have caused the shift? How do you deal with it? What would you do differently if possible?
• Apply reading strategies to relate prior knowledge to new information.	**Type IV** With a partner, role-play a therapy session with either Juliet, Romeo, Friar Laurence, Tybalt, or Nurse. Sculpt an image, emotion, or feeling you would most like to convey to another person. Why have you been unable to communicate thus far?
• Apply reading strategies to relate prior knowledge to new information. • Apply reading strategies to make useful connections to other topics. • Analyze literature for the universality of themes.	**Type V** Participate in a panel discussion on one of the universal themes or values we have discussed throughout the play. A connection to the contemporary world needs to be made. Who is a foil in your life? What does that say of you? Of the foil? Convey or portray this pairing.

Theme: Universality of Human Experience Unit: *Romeo and Juliet*

Intelligence: Linguistic

Arizona State Standards	**Problems**
• Use grammar and usage to sharpen focus and clarify meaning for writing.	**Type I** For the following vocabulary word you will need to find a definition, indicate the part of speech, and use the word in a sentence. Prose Verse Elizabethan Soliloquy Sonnet Toil Strive Pernicious Covert Portentous.
• Apply reading strategies such as interpreting and extracting.	**Type II** Select on of Romeo and Juliet's conversations to perform with a partner. Prepare your oral interpretation considering the author's intent and poetic forms.
• Write an analysis of an author's use of literary elements.	**Type III** Analyze one of the following sets of lines. Write an analytical essay to explain Shakespeare's use of language to create both a comedic and tragic moment simultaneously. Translate the set of lines into contemporary English, maintaining the author's intent and his play with language. Act I, i, 1-51 Act I, ii, 45-83; Act I, iv, 1-53; Act II, v, 21-65.
• Write a creative story that develops complex characters, plot structures, etc.	**Type IV** Write an additional scene to *Romeo and Juliet*. You may select the act and scenes it follows. Be attentive to literary conventions and maintaining fluency between your scene and the rest of the play. Your scene must contribute substantially to the play without violating the integrity of it.
• Use the writing process to effectively complete a variety of writing tasks for various audiences.	**Type V** Use any combination of literary elements seen in *Romeo and Juliet* in an original piece of writing. Elements may include: dramatic irony, simile, metaphor, sonnet, soliloquy, verse-prose, irony, alliteration, personification, punning, classical references, etc.

Theme: Universality of Human Experience Unit: *Romeo and Juliet*

Intelligence: Logical-Mathematical

Arizona State Standards	Problems
• Use phonetic and structural analysis skills.	**Type I** In the Prologue of Act I (the first sonnet in *Romeo and Juliet*!), mark the stressed and unstressed syllables of the iambic pentameter in each line. Indicate the feet and appropriate stanza breaks (8-6 or 6-6-2). Please also indicate any hypermetric lines and provide a possible meter interpretation.
• Share by reading fluently and expressively. • Deliver oral interpretation of literary work.	**Type II** Prepare either Prologue (from Act I or Act II) for oral presentation. (Both are sonnets). Memorize and perform the sonnet with appropriate rhyme scheme and iambic stresses.
• Interpret, analyze, and evaluate use of figurative and literal language.	**Type III** Shakespeare has been very sly in some of his sonnet use by making a sonnet out of seemingly innocent dialogue or soliloquy. Analyze Acts II and III for hidden sonnets. When you find a sonnet, mark it according to iambic pentameter on your paper.
• Demonstrate the ability to sequence, analyze, categorize, and use logical reasoning in a writing task.	**Type IV** Select a portion of dialogue between 2 characters. Translate the dialogue into a sonnet. The 14 lines will still be a dialogue. Be attentive to rhyme and meter requirements as well as dialect issues for Shakespeare's English.
• Use the writing process to effectively complete a writing task.	**Type V** Write a sonnet in contemporary English. You will need to be sensitive to natural stresses in order to fulfill the meter requirements of iambic pentameter while still preserving a natural evolution of the sonnet.

Theme: Universality of Human Experiences Unit: *Romeo and Juliet*

Intelligence: Musical

Arizona State Standards	**Problems**
• Apply reading strategies such as extracting, summarizing, clarifying, etc.	**Type I** Read Act II, scenes v, vi together in class. Produce the sounds that would have occurred as those scenes were performed.
• Recognize, analyze, and evaluate an author's use of mood and tone.	**Type II** Use the provided musical selections to support Act II, scenes v, vi. You are essentially creating a soundtrack for these scenes. You must convey both the superficial and deeper feelings Shakespeare is working with. Create a tape (or burn a CD) with your work. Music selections include excerpts from Wagner, Gypsy Kings, Johnny Cash, and Duke Ellington.
• Write a creative story (in this case, song lyrics) that includes sensory details and concrete language to advance the story line.	**Type III** Write the lyrics to the love songs of Romeo or Juliet in Act II. You are creating the lyrics to reveal the characters of either Romeo or Juliet as a young person in love. Create an original melody that would accompany the songs.
• Deliver oral interpretations of literary works.	**Type IV** Listen to the recordings of Act I, scene i. We are hearing 5 different actors from different eras of theatre reading. Note how dramatically their reads change your emotional response. Select a passage to read in a variety of manners. You need to convey relevant emotions – but have completely different reads. You can work in small groups and have different people do the different reads, if you would like. Be conscious of tone and voice.
• Write a creative story (in this case, a scene) that includes sensory details and concrete language to advance the story line.	**Type V** Use a variety of instruments to depict a moment from *Romeo and Juliet* (you should cover at least a scene). Your musical performance should convey the moment to us – without any words. This is a *Peter and the Wolf* sort of production!

Theme: Value Systems Unit: *Romeo and Juliet*

Intelligence: Spatial

Arizona State Standards	**Problems**
• Plan, develop, and produce a visual presentation.	**Type I** Make a reproduction of Shakespeare's Globe theatre and the surrounding neighborhood. Reflect social concerns of the time in your reproduction.
• Apply reading strategies such as interpreting, extracting.	**Type II** Select an object and portray the disintegration of Romeo's mental state through each act. (Juliet's disintegration is also an option.)
• Interpret author's use of figurative and literal language.	**Type III** In Act I, Scene i Shakespeare uses his characters' lines to connote the values of Elizabethan England. Select 4 to 6 lines and visually display the lines to portray the values.
• Recognize the author's use of figurative language.	**Type IV** Demonstrate, through a diorama, Shakespeare's figurative language in a specific moment of *Romeo and Juliet*.
• Analyze complex texts to discern the universality of themes.	**Type V** Convey a universal element of human existence seen today and in *Romeo and Juliet*.

Theme: Universality of Human Experiences Unit: *Romeo and Juliet*

Intelligence: Spiritual

Arizona State Standards	**Problems**
• Analyze and evaluate the impact of visual media on the intended audience.	**Type I** Watch the 1996 movie *William Shakespeare's Romeo and Juliet*. List several specific examples of religious imagery the director uses. Be sure to indicate, with as much detail as possible, the point in the play at which the imagery is used.
• Compare and contrast cultural perspectives of a literary selection. • Analyze world literature for the universality of themes.	**Type II** In small groups (teacher assigned) identify the universal elements or ideas that exist in contemporary religions with which you are familiar. Which of these universals appear in Romeo and Juliet? Convey your group ideas to the class.
• Craft a cohesive research document that develops a logical argument or thesis. • Analyze world literature for the universality of themes.	**Type III** Research Elizabethan England or Renaissance Europe and their spiritual belief systems. Demonstrate how these various beliefs appear in Romeo and Juliet.
• Apply reading strategies to relate prior knowledge to new information.	**Type IV** Use you belief system to discuss/depict/comment on the actions of the principal players in this story.
• Apply reading strategies to relate prior knowledge to new information. • Plan, develop, and evaluate an effective multimedia presentation.	**Type V** How does your spirituality shape your daily life in the contemporary United States? How did it shape the daily lives of Romeo and Juliet? Address these questions.

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