2001


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UMI
AN EXPLORATORY STUDY OF THE INFLUENCE OF NATIONAL AND
STATE STANDARDS ON MIDDLE SCHOOL SCIENCE TEACHERS' CLASSROOM ASSESSMENT PRACTICES

A Dissertation

Submitted to the Graduate Faculty of the Louisiana State University and Agricultural and Mechanical College
in partial fulfillment of the requirements for the degree of Doctor of Philosophy

in

The Department of Curriculum and Instruction

by

Kathy Jean McWaters
B.S., Louisiana State University, 1969
M.S., Louisiana State University, 1970
Ed.S., Louisiana State University, 1999
August, 2001

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In Memory of

Marcus Mott McWaters
ACKNOWLEDGEMENTS

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ABSTRACT

Classroom assessment practices of middle school science teachers were identified and the influence of national and state science standards on these practices was examined. In Phase I of this study a mail questionnaire was sent to 450 middle school (grades 5, 6, 7 and 8) science teachers in 17 parishes in Louisiana to obtain information about their classroom assessment practices. In Phase II, nine middle school teachers in eight departmentalized classrooms, two classes at each grade, participated in a qualitative study. Data were collected through questionnaires, classroom observations, interviews and document analysis.

Data analysis revealed three major categories of classroom assessment targets: (a) student achievement, (b) student attitudes and, (c) student products. Results indicated that most teachers are using different assessment methods when assessing different achievement targets, as recommended by science reform documents. It was also determined that many teachers are using appropriate methods to assess student learning.

While teachers reported that students spend an inordinate amount of time engaged in assessment activities, classroom observations suggested that the activities were not always written tests or graded activities. Another key finding is that there is a disconnect between the quality of teaching and the quality of assessment. Teachers who teach the material recommended by science reform documents and use recommended instructional strategies were observed to stop teaching and engage students in a “test rehearsal” geared towards rote memorization of factual information.
Data suggest that the national and state science content standards are influencing the content and the format of teacher-made tests. Teachers' reported using the standards during assessment construction or selection in a wide variety of ways. The most direct use of the standards reported was to select content, format and cognitive level for test items. A more circumspect approach used by teachers was to use the standards to write lesson plans and objectives and then to plan assessments based on these teacher-constructed objectives. Questionnaire data indicated that the three factors having the most influence on teachers’ selection or construction of a particular type of assessment were (a) how students learn, (b) alignment with state/district standards, and (c) purpose for assessment.
INTRODUCTION

Curriculum content, instructional strategies and assessment practices provide the foundation for student learning in the classroom. Traditionally, research in education concentrated on curriculum and/or instruction. When assessment issues were addressed, the majority of research studies centered on large-scale assessment practices. Recently, a small but growing number of research studies have focused on classroom assessment issues and concerns (Lorsbach, Tobin, Briscoe, & Ulerick, 1992; McMorris & Boothroyd, 1993; Morais & Miranda, 1996; Oescher & Kirby, 1990; Ruiz-Primo, Ayala, & Shavelson, 1999; Shepardson & Adams, 1996).

Articles focusing on classroom assessment practices are becoming more common in education journals and, in 1998, an entire issue of the journal of Assessment in Education: Principles, Policy & Practices (Broadfoot, 1998) was devoted to the subject. Additionally, a basic premise of the National Science Education Standards (1996) is that assessing students' opportunity to learn science is as important as assessing student achievement. Wiley and Yoon (1995) recommended that opportunity to learn (OTL) focus on learning goals and the instructional strategies related to them. Furthermore, for the first time since 1969, the International Association for the Evaluation of Educational Achievement included a video study of classrooms across three countries testifying to the importance of the relationship between classroom instructional practices and assessment and the need to make classroom observations part of the research design. The study, conducted in 1996, was the Third International Mathematics and Science Study (TIMSS).
Background

The current science reform movement, affecting curriculum, instruction and assessment practices has found its voice in multiple national and state publications from a variety of organizations and has rekindled an interest among researchers in improving classroom assessment practices. One of these groups, the American Association for the Advancement of Science (AAAS), founded in 1848, is the world’s largest federation of scientific and engineering societies. Since the Sputnik era, it has developed multiple projects to advance science literacy in the nation. Today one of its best known efforts is Project 2061, a committee of scientists and educators, which began in 1985, the year Halley’s Comet was last here. Its purpose is to help transform the nation’s school system so that all students become well educated in science, mathematics, and technology before the comet’s return in the year 2061.

Project 2061 defined adult scientific literacy and made recommendations about what students should know and be able to do by the time they graduate from high school (American Association for the Advancement of Science [AAAS], 1989). They also established benchmarks (AAAS, 1993) which set forth what students should know and be able to do as they reach selected grades in their journey toward scientific literacy. Both the guidelines and the benchmarks for scientific literacy offer teachers a rich tool for planning curriculum. However, once the teacher has planned the curriculum for a particular grade and provided instruction to achieve curriculum goals, the teacher must then decide whether or not the students have met their goals. For a student to attain a benchmark, s/he must have understanding sufficient to make sense of what was already learned and sufficient to learn more (AAAS, 1993).
While it is recognized that thoughtful teachers are an important source of knowledge on student learning, it is also recognized that teachers have limitations. "Teachers have little time to conduct careful assessments of student learning, lack instruments for assessing richly connected learnings and higher-order thinking skills, and rarely have opportunities to compare their experiences with others who teach the same concepts and skills" (AAAS, 1993, p. 327). Therefore, the members of the Project 2061 committee turned their attention to formulating recommendations concerning classroom assessment. Guidelines were issued that directly addressed how teachers should assess science learning in the classroom (AAAS, 1997).

These recommendations or "blueprints" for classroom assessment grew out of the conviction of Project 2061's members that serious efforts to achieve science literacy goals (AAAS, 1989) must be based on an understanding of education as a system. Accordingly, twelve components of education as a system were identified with assessment being one of the twelve. The following recommendations for improved classroom assessment were made:

1. Assessment and Science Content. The content of assessment activities should reflect the national and state standards and benchmarks. In designing assessments, educators should refer to their state frameworks, being mindful that students need to understand standards and benchmarks and not memorize them (AAAS, 1997).

2. Assessment Philosophy. Assessments should frequently test student familiarity with and comprehension of systems, models, constancy, patterns of change, evolution and scale, as well as assessing their habits of mind—curiosity,
openness to new ideas, and skepticism—as described by Project 2061 (AAAS, 1989). Students should address such questions as, “How do we know this?” and “What difference does it make?” rather than being asked to reproduce memorized vocabulary terms or the like. Teachers should be presented with the outcomes they are expected to achieve—contained in frameworks based on national standards and benchmarks—and then be free to design their own methods of instruction and assessment (AAAS, 1997).

3. Assessment Strategies. Curriculum units and the assessments that accompany them or that are selected or developed by science teachers—should be analyzed using a valid, comprehensive, and standardized procedure that describes their alignment with benchmarks and standards. A variety of science assessment techniques that require students to use higher-order thinking skills should be used. Assessments should include open-ended items, essays, projects, portfolios, exhibits or displays, and other strategies that test students’ ability to generate answers and support their positions rather than simply recall data or select responses from several options. Students should be assessed on their abilities to make accurate measurements and use evidence to solve problems (AAAS, 1997).

4. Assessment and Learning. Science activities and assessments can be mingled to provide increased opportunities for student learning. Student understanding of the nature of science and the world should be an assessment target. And, students should be provided with multiple opportunities to take responsibility
for their own learning, by helping the teacher design assessments and determine evaluation criteria (AAAS, 1997).

In addition to the AAAS, The National Academy of Sciences joined the effort to promote students’ scientific literacy. According to DeBoer (2000): “Begun in 1992, the National Science Education Standards (NSES) (1996) is part of the U.S. government’s approach to education reform, an approach that involves setting national goals and the standards for meeting them” (p. 590). The national standards (National Research Council [NRC], 1996) offer content standards as learning goals for students just as the benchmarks do; additionally, national standards also offer guidance for teachers and other science educators about: (a) teaching standards, (b) assessment standards, (c) professional development standards (d) program standards, and (e) system standards.

The vision of science teaching and learning offered in the Standards is that students are actively engaged in the process of learning. Moreover, the engagement must be both physical and mental. Not only must students engage in experimenting, problem solving, planning, decision making and group discussions, they must also experience assessments that are consistent with an active approach to learning.

The following essential characteristics of exemplary assessment practices are included in the national standards (NRC, 1996) and are offered as guides for the development of assessment tasks and practices: (a) assessments must be consistent with the decisions they are designed to inform, (b) both achievement and opportunity to learn science must be assessed, (c) the technical quality of the data collected must be matched to the decisions and actions taken on the basis of their interpretation, (d)
assessment practices must be fair, and (e) the inferences made from assessments about
student achievement and opportunity to learn must be sound (see Table 1.1).

Building on and reinforcing these national recommendations, state curriculum
and assessment specialists (Louisiana State Department of Education [DOE], 1997),
suggested that teachers should allow the purpose of the assessment to determine the
assessment technique. Furthermore, they proposed that classroom assessment should
parallel instruction, be fair and equitable, include data from multiple sources,
encourage the development of higher order thinking skills and require students to
demonstrate scientific problem solving and conceptual knowledge. Teachers were,
therefore, encouraged to design forms of active assessment that are embedded in
instruction (DOE, 1997).

Additionally, the DOE introduced a plan for developing a state assessment
system. “This plan outlines the structure of standards-based assessment and provides
illustrative examples of grade-level benchmarks, performance expectations, and
assessment items” (DOE, 1998, p. 1). Teacher workshops across the state introduced
teachers to the state assessment plan and the specific formats included on the state’s
new high-stakes test. In spite of these efforts, there is no way to determine whether or
not the documents containing these guidelines and recommendations are in the hands
of the teachers or on library shelves. There is even less certainty of the influence that
these recommendations are having on the teachers’ classroom assessment practices
and students’ opportunity to learn science material. One indicator of the effect science
standards have in the classroom is the way in which day-to-day teaching and
assessment practices of teachers are carried out.
Table 1.1

The National Science Education Assessment Standards

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<td>Assessments must be consistent with the decisions they are designed to inform.</td>
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<tr>
<td>• Assessments are deliberately designed.</td>
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</tr>
<tr>
<td>• Assessments have explicitly stated purposes.</td>
<td></td>
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<tr>
<td>• The relationship between the decisions and the data is clear.</td>
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<tr>
<td>• Assessment procedures are internally consistent.</td>
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<td>B</td>
<td>Achievement and opportunity to learn science must be assessed.</td>
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<tr>
<td>• Achievement data collected focus on the science content that is most important for students to learn.</td>
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<tr>
<td>• Opportunity-to-learn data collected focus on the most powerful indicators.</td>
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<td>• Equal attention must be given to the assessment of opportunity to learn and to the assessment of student achievement.</td>
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<td>C</td>
<td>The technical quality of the data collected is well matched to the decisions and actions taken on the basis of their interpretation.</td>
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<tr>
<td>• The feature that is claimed to be measured is actually measured.</td>
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<td>• Assessment tasks are authentic.</td>
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<td>• An individual student’s performance is similar on two or more tasks that claim to measure the same aspect of student achievement.</td>
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<td>• Students have adequate opportunity to demonstrate their achievements.</td>
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<td>• Assessment tasks and methods of presenting them provide data that are sufficiently stable to lead to the same decisions if used at different times.</td>
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<td>D</td>
<td>Assessment practices must be fair.</td>
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<td>• Assessment tasks must be reviewed for the use of stereotypes, for assumptions that reflect the perspectives or experiences of a particular group, for language that might be offensive to a particular group, and for other features that might distract students from the intended task.</td>
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<td>• Large-scale assessments must use statistical techniques to identify potential bias among subgroups.</td>
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Table 1.1 continued

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<th>Standard</th>
<th>Elaboration</th>
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<td>E • Assessment tasks must be appropriately modified to accommodate the needs of students with physical disabilities, learning disabilities, or limited English proficiency. • Assessment tasks must be set in a variety of contexts, be engaging to students with different interests and experiences, and must not assume the perspective or experience of a particular gender, racial, or ethnic group.</td>
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<td>The inferences made from assessments about student achievement and opportunity to learn must be sound.</td>
<td>• When making inferences from assessment data about student achievement and opportunity to learn science, explicit reference needs to be made to the assumptions on which the inferences are based.</td>
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Purpose of the Study

The twofold purpose of this study is (a) to identify classroom assessment practices of middle school science teachers and (b) to explore the relationship between these classroom assessment practices and those recommended by national and state science standards.

Research Questions

The following research questions are addressed in this study:

1. What are the classroom assessment practices (CAPs) of middle school science teachers?

2. To what extent do the national or state science standards influence CAPs?

The subquestions of research question two are:

a. Are teachers providing students with the opportunity to learn the material in national or state content standards?
b. Do teachers' views on science teaching and learning support the vision of science learning set forth in science reform documents?

Importance of the Study

With few exceptions, (e.g., Cizek, Fitzgerald, & Rachor, 1995; Shepardson & Adams, 1996) research studies designed to understand United States science teachers' classroom assessment practices occurred before 1989 and so predate the publication of current national and state science reform documents. Consequently the studies were not focused on the influence of national and state standards on teachers' classroom assessment practices. The results of this exploratory study inform university science educators and others interested in science reform about the extent to which science reform efforts have had an impact on selected middle school teachers' classroom assessment practices. Moreover, knowledge of teachers' assessment practices is useful in the development of effective inservice programs designed to improve CAPs which in turn can promote meaningful student learning rather than rote learning. Finally, this study contributes to an understanding of what teachers do and why they do it—knowledge vital in the efforts to improve classroom science teaching and learning.

Definition of Terms

The following terms are used throughout the study:

1. Assessment. Assessment is a systematic, multistep process involving the collection and interpretation of educational data. The four components of the assessment process include: data use, data collection, methods to collect data and users of data (NRC, 1996, p. 77).
2. Benchmarks. This term is used as a name for the goal statements for what students should know and be able to do at the end of each grade cluster. The benchmarks are offered as reference points for analyzing existing or proposed curricula in the light of science-literacy goals. (AAAS, 1993, p. 317).

3. Blueprints. For each component of the education system, major issues are identified and strategies are suggested for effecting those changes which support the proposed Project 2061 curriculum reforms (AAAS, 1993).

4. Grade cluster. Reform documents have grouped the grades in two different ways. Project 2061 (AAAS, 1993) uses grade clusters: K-2, 3-5, 6-8, and 9-12. The National Research Council (1996) clusters grades: K-4, 5-8, and 9-12.

5. A Science-Literate Person. A literate person is an educated person, one having certain knowledge or competencies. People who are literate in science are able to use the habits of mind and knowledge of science, mathematics, and technology they have acquired to think about and make sense of many of the ideas, claims, and events that they encounter in everyday life (AAAS, 1993, p. 322).

6. Standards. A standard, in its broadest sense, is something against which other things can be compared for the purpose of determining accuracy, estimating quantity, or judging quality (AAAS, 1993, p. 322).

7. Opportunity to Learn Standards (OTL). Legislation defines OTL standards broadly to include: "the criteria for, and the basis of, assessing the sufficiency or quality of the resources, practices, and conditions necessary at each level of the education system (schools, local educational agencies, and states) to
provide all students with an opportunity to learn the material in voluntary national content standards or State content standards” (Pub. L. No. 100-327, 3[7] cited in McDonald, 1995).

8. Authentic assessment. Authentic assessment exercises require students to apply scientific knowledge and reasoning to situations similar to those they will encounter outside the classroom or to situations that approximate how scientists do their work (NRC, 1996).

Scope and Limitations

In the first part of this study, middle school science teachers across the state were asked to complete a self-report questionnaire. Questionnaire responses were used to gather demographic information, to identify teachers' classroom assessment practices, to understand teachers' views on how learning occurs and the roles of teachers and students in the learning process, and to probe students' opportunities to learn school science. The limitations of questionnaires are well documented in the literature (Czaja, R. & Blair, J., 1996; Gall, Borg, & Gall, 1996) and include the inability to clarify the meaning of items for participants or to probe more deeply into the responses of the participants. Additionally, self-report questionnaires have a major disadvantage of being affected by the person who is reporting (Tashakkori & Teddlie, 1998) and teachers may not be consciously cognizant of their instructional practices and so may be unable to describe fully what they do (Good & Brophy, 1973).

A limitation specific to this study is that 40 school districts were invited to participate and 17 of the 40 school districts had teachers who completed and returned questionnaires. A simple comparison of the number of students, number of faculty
and class size ranges reported in the Louisiana Progress Profiles State Report (DOE, 1997-1998) was made to identify some of the differences between the parishes returning and those not returning questionnaires. It was expected that it would be the parishes with a large number of teachers and students that would not participate. However a random sample of 10 non-participating school districts revealed that have the districts were large districts employing over a thousand teachers but the other have were small districts employing less than 800 employees. Comparisons made between responding and non-responding districts showed no important differences in terms of class size.

In an effort to compensate for the limitations of quantitative data collected using mail questionnaires, the second part of this research study employed qualitative methods. In addition to completing the assessment questionnaire, face-to-face interviews were conducted with nine teachers to discuss their assessment practices; and, classroom observations were made as these same teachers engaged in the teaching/learning/assessing process in their own classrooms. By combining observations and interviews it is possible to offset the disadvantages of one technique with the advantages of the other technique (Adler & Adler, 1998). For example, by using interviews along with observations the researcher can ask about the cause or intent related to an observed behavior. Without the benefit of the interview data, the researcher could only speculate about the cause or intent of the behavior.

This qualitative phase of the study focused on the classroom assessment practices of public school teachers employed to teach science to fifth, sixth, seventh and eighth grade students in one school district in Louisiana. This phase of the study
involved teachers in the district in which the researcher is employed in the central office as the coordinator for curriculum and staff development. While the job description does not include the direct supervision of teachers, the researcher is perceived by some teachers to be a supervisor. The teachers in the study were all volunteers and seemed to understand that this study was not in any way connected to their current or future employment status. However, one might speculate that the teachers who did not volunteer may have perceived the situation differently. On the other hand, the participants were very open and honest in their answers on both the questionnaire and in the interviews. An advantage of working in the parish where the researcher is known by teachers and students is that the researcher was relatively invisible in the classroom because the students were already accustomed to seeing the researcher in and around the classrooms and schools.

Content analysis was used to explore the relationship between the standards and benchmarks and the assessment documents constructed or selected by the teachers. While content analysis is a useful technique, it has documented limitations (Bordens & Abbott, 1996). One limitation is that content analysis is purely descriptive; it cannot establish causal relationships among variables. A second limitation is that in some instances, results from a content analysis are invalidated over time. The researcher decided that the above mentioned limitations would not be detrimental to this exploratory study for two reasons: (a) this study is designed to be a descriptive study and (b) the assessment analysis framework used to analyze the content of teacher-made tests is directly related to the science standards and benchmarks, authored by Project 2061 members, and should remain valid as long as
the results are viewed within the context of the science content standards and benchmarks.
REVIEW OF LITERATURE

The twofold purpose of this research project was (a) to identify the classroom assessment practices of middle school (grades 5-8) teachers and (b) to explore the relationship between these practices and those recommended by national and state science standards. To address these concerns a review of literature was conducted to identify the current situation. What does research tell us about classroom assessment practices? Do teachers' beliefs, attitudes, and/or views about assessment and learning influence the way they assess student learning? Is there evidence that national science standards and benchmarks are influencing how student learning of science is assessed? Is there evidence that student achievement increases when teachers use a standards-based approach to assessment? The following topics are described within a review of the literature: (a) teachers' beliefs and attitudes about assessment, (b) teachers' views on science teaching and learning, (c) opportunity to learn, (d) classroom assessment practices research, and (e) assessment reform in the science classroom.

Teachers' Beliefs and Attitudes About Assessment

Inconsistencies in the Constructs of Belief, Attitude and Knowledge

Attitudes and beliefs can be included in a subset of a group of constructs which define and describe mental states that influence action (Richardson, 1996). Not surprisingly, attitudes have been conceptualized in different ways by different researchers. Some researchers conceptualized attitudes and beliefs as one construct (Allport, 1967; Rokeach, 1968) and others, such as Fishbein (1967) chose to separate attitudes (affective) and beliefs (cognitive). Recently, Pajares (1992) added to the
discussion by suggesting that attitudes, values, preconceptions, theories and images are beliefs in disguise.

The inconsistent use of the terms belief and attitude extends to the term knowledge as well. According to Richardson (1996) "the most complex issue in current research on teaching and teacher education is the confusion between the terms belief and knowledge" (p. 104). Teachers, as well as researchers, seem to view the terms belief and knowledge as interchangeable. Based on four case narratives, Shepardson & Adams (1996) concluded that teachers treat their beliefs about learners as knowledge that informs their pedagogy and assessment practice. Teachers' "knowledge" of their students provides a framework for what is appropriate pedagogy and assessment. Their findings support an earlier assertion by Dietel, Herman & Knuth (1991) that methods of assessment are determined by teachers' beliefs about learning.

Tobin & LaMaster (1995) defined belief as "knowledge that is viable in that it enables an individual to meet her goals in specific circumstances. Beliefs are tied to the situations in which actions are contemplated" (p. 226). For example, they found that one teacher associated assessment with rewards and punishment and seemed focused on students' failure. As a result, her beliefs about her role as assessor created student hostility. This hostility dissipated when she changed her beginning metaphor of "fair judge" to a "teacher looking through a window into the student's mind" and then changed her assessment practices to reflect her new metaphor. This study supported the concept that beliefs prompt action (Oliver & Koballa, 1992).
Beliefs and Attitudes about Classroom Assessment Practices

Common Elements Among Teachers' Beliefs, Attitudes and Knowledge

Focusing on science educators and using survey research methods, Oliver & Koballa (1992) found that while science educators have different conceptions about beliefs, some common elements can be identified: a relationship between beliefs and knowledge, the idea that beliefs are acquired through communication, and the concept that beliefs prompt action. Because beliefs may affect actions, teachers' beliefs play a critical role in implementing science assessment reform. Several researchers have identified teachers' beliefs and attitudes about assessment.

Teachers' Beliefs, Attitudes and Knowledge About Assessment

In general, it was found that teachers (a) valued assessments that provided information relevant to the decisions they may face (Salmon-Cox, 1980), (b) believed that they knew the needs of their students, and, (c) thought state diagnostic tests were not needed (Shulman, 1980). Additionally, results from a national survey in which teachers rated the importance of various forms of assessment in making classroom decisions clearly showed that teachers preferred their own assessments and relied most heavily on teacher observation and opinions (Dorr-Bremme & Herman, 1986). However, though they reported relying on their own assessments, teachers also reported feeling insecure about their test making capabilities (Carter, 1984).

During a study by Herman & Golan (1992) regarding the relevance of standardized tests to classroom practice, teachers reported that they did not believe standardized testing was helping schools to improve or that testing helped clarify school goals, provide useful feedback, or assess the most useful learning for students.
Teachers’ Views on Science Teaching and Learning

Nature of Knowledge and How Students Learn

Differences Among Teachers’ Views

Although educational researchers recognize that it is difficult to distinguish between views and beliefs (Prawat, 1992), many suggest that pedagogical decisions in science classrooms are rooted in an understanding of the nature of knowledge and how students learn (Glasson and Lalik, 1993; Park & Coble, 1997; Simmons et al., 1999).

In a study conducted by Hashweh (1996), Palestinian science teachers were placed into one of four groups based upon their views of science teaching and learning. The author reported that there were two constructivists groups (learning constructivists and knowledge constructivists) and two empiricist groups (learning empiricists and knowledge empiricists). These groups were not mutually exclusive; therefore, some teachers belonged to two groups simultaneously. It was reported that 16 out of 35 participating science teachers could be classified as “Learning Constructivist” teachers because they emphasized the active role of the learner in constructing knowledge to understand the world. In addition they were aware that students develop many ideas on their own which may differ from the science community. These teachers believed that science learning involved conceptual change and that teaching science required confronting students’ alternative conceptions.

In contrast, “Learning Empiricists” (6 of the teachers in this study) emphasized the role of external reinforcement in learning, did not believe that students develop ideas in science on their own, were not aware of the existence of alternative conceptions, and advocated ignoring such ideas, if they did exist. Of the remaining
teachers, 6 were identified as "Knowledge Constructivists" while 18 were described as "Knowledge Empiricists". Teachers in this last group viewed science knowledge as objective, permanent, and discovered. They believed the aim of science to be fact collection and in the classroom emphasized the scientific method and the gradual and cumulative aspects of the growth of scientific knowledge rather than the conceptual change aspect. These findings reported by Hashweh (1996) support the idea that teachers hold different views about science and science teaching. Additionally, the author concluded that constructivist teachers' beliefs resulted in the use of more effective strategies (such as the use of multiple-type strategies that help acquisition of new concepts, confront alternative conceptions, and facilitate cognitive restructuring) for inducing student conceptual change.

Even when teachers report using recommended classroom practices, the exact nature of the practice may vary among teachers. Hewson, Kerby, and Cook (1995) suggested that there is a reason for not automatically assuming that when teachers advocate the use of questioning as an important part of instruction that they use questions for the same reasons. One teacher used questioning as a means of getting students tuned in and assisting a teacher-lead discussion; the second asked questions to provide him with feedback from the class; and the third teacher used questioning as a key to lead into student discussion and discovery learning. The authors concluded that if science reform efforts are to succeed in changing the way school science is taught and assessed, it is important to know teachers' views on (or beliefs about) science teaching and learning and how their views impact their classroom practices.
Similarities Among Teachers’ Views

While teachers’ views may differ based on personal understandings and experiences, common threads can be discovered among their views of science teaching and learning. Using 116 metaphors generated by pre-service science teachers, Gurney (1995) concluded that student teachers tend to view the teaching/learning dynamic as one of four processes: a) delivery, b) change, c) enlightenment, or d) humanics (sic). Within each theme there were different expressions of mood which reflected the teachers’ understanding of the roles of teacher and learner and exposed their perspectives on the nature of knowledge. For example, one teacher wrote: “Teachers are tug boats, tiny but strong, pulling the giant ships of society’s youth towards knowledge and understanding that will allow them to survive in the ocean of the future” (p. 577). A less aggressive teacher is quoted as writing: “The ideal teacher is a guide who points the student in the direction of the knowledge and shows the student how to attain that knowledge” (p. 577). Both of these excerpts are considered examples of an enlightenment metaphor. Gurney (1995) further suggested that these views are shaped by the student teachers’ own prior experiences as learners.

Influence of Beliefs and Experience on Change

Shared Teacher and Student Beliefs

Researchers propose that teachers’ beliefs and views can either change (Park & Coble, 1997; Powell, 1994; Simmons et al., 1999; Tobin & LaMaster, 1995) or be reinforced (Lee, 1995; McRobbie & Tobin, 1995) as a consequence of their teaching experiences. McRobbie & Tobin (1995) found that when a high school chemistry
teacher and his students shared the same beliefs about science teaching and learning that there was little impetus for change. The teacher believed his role was to identify the most important facts, present the facts clearly, and help the students to memorize them. He believed that understanding occurred almost automatically, after the students had memorized a critical mass of facts. His students believed that knowledge came from the teacher and the textbook. “He has to give us the knowledge” (p. 380). Given the “fit” in this particular classroom, reform efforts will have minimal effect because neither the teacher nor his students see a reason to change.

Views of Classroom Management

It was suggested by Lee (1995) that the congruence between administrators’ and teachers’ views of discipline may also hinder reform efforts. Lee (1995) reported that one middle school science teacher, concerned with classroom management and a weak knowledge of science content exhibited a heavy dependence on students’ individual seatwork from the textbook and avoided whole-class discussions or group activities. However, this teacher was commended by the administrators for her management skills (given an advanced class) and her lack of science knowledge and appropriate instructional practices were hardly addressed.

Teacher Experience

Several researchers have created situations in which teachers were provided with a safe environment in which to articulate their views of science teaching and learning, compare their views with others, and experiment with a variety of instructional practices. Park & Coble (1997) worked with middle school teachers as they designed curriculum and tried out new approaches to teaching science. They
reported that an inservice program focusing on curriculum development could be used as a vehicle for sustained school reform and that teachers built "a more informed knowledge base about the content of science and alternate representations of content held by students" (p.785).

Supporting this notion of using curriculum development as a vehicle for changing teacher views about science teaching, Bencze & Hodson (1999) used teacher action research to collaborate with two teachers to design and implement more authentic science in a Grade 7 classroom. It was reported that both of these teachers viewed science as "a body of complex and conceptually difficult knowledge properly understood only by experts" (p. 531). They viewed the role of the elementary school teacher as merely the person who transmitted information to students. The information transmitted was selected, organized and sequenced by a more knowledgeable expert, a science specialist. As a result of their teacher action research project, both teachers made significant changes. They became more knowledgeable about science, more self-confident in their abilities to make curriculum decisions and more committed to critical reflective practice. Bencze & Hodson (1999) cautioned that

Because teachers’ views are built up over a long period and are burnished in the furnace of everyday practice, challenges must be vigorous and explicit if change is to occur. However, too vigorous a challenge can result in feelings of anxiety, vulnerability, and insecurity (p. 531).

Simmons et al. (1999) studied beginning teachers across several teacher education programs and asserted that while beginning teachers (3 years experience or less) described their practice as very student-centered, classroom observers reported that they behaved in teacher-centered ways. Their findings indicated that as the
teachers gained classroom teaching experience they became more, not less, teacher-centered. According to Simmons et al. (1999),

Teachers believed they were student-centered in how they viewed themselves as teachers, but were teacher-centered in their classroom actions, and did not discover or reconcile this inconsistency. The idea that learning occurs through a process of negotiation between teachers and students (bringing together diverse educational backgrounds of knowledge, experiences, and expectations) is ignored or reflected in expressing student-centered beliefs but acting in teacher-centered ways (p. 948).

This finding as noted by the authors, seems to reinforce what we know about learners of all ages, that these beginning teachers held personal constructions that were incomplete or contradictory.

Opportunity to Learn

Origins of Opportunity to Learn

A basic premise of the national science education standards is that assessing students' opportunity to learn science is as important as assessing student achievement (NRC, 1996). Opportunity to learn (OTL) is a construct pioneered and named by the International Association for the Evaluation of Educational Achievement (IEA), a consortium of nations and research institutes (Doran, Lawrenz, & Helgeson, 1993). Originally, data about OTL was collected using survey research methods. Teachers responded to written questions concerning students' exposure to material pertaining to individual test items. Newer thinking about OTL focuses on learning goals and instructional strategies related to them (Wiley & Yoon, 1995).

There is no agreement among researchers as to which particular set of factors best measures OTL. Therefore, different researchers have used different factors. Proposed designs for new indicator systems advocate including measures such as:
teacher background and experience, school- and grade-level organization, course offerings, curriculum content, instructional materials availability and usage, and instructional strategies (McDonnell, 1995). Others suggest that if OTL standards are to point to directions for improved student learning, then they must consider how a teacher instructs—not what the teacher knows; and, how textbooks are used to provide students with access to worthwhile content—not just their availability (Porter, 1995).

**Classroom Indicators of Opportunity to Learn**

However, the NRC has identified what they consider to be the most powerful indicators of students opportunity to learn in the science classroom. Stressing the importance of OTL, the national assessment standards (NRC, 1996) call for the assessment of OTL, as well as student achievement, and identify what they consider to be the most powerful indicators of students' OTL.

At the classroom level, some of the most powerful indicators of opportunity to learn are teachers' professional knowledge, including content knowledge, pedagogical knowledge, and understanding of students; the extent to which content, teaching, professional development, and assessment are coordinated; the time available for teachers to teach and students to learn science; the availability of resources for student inquiry; and the quality of educational materials available (p. 82).

**Methods Used to Collect Data on Opportunity to Learn**

Herman & Klein (1997) explored OTL using data collected as part of a pilot study of eighth-grade mathematics for a statewide assessment system. Their results suggested that surveys of either students or teachers can be used "to obtain accurate data on what is going on in classrooms and on the broad nature of the teaching and learning activities in which students have been engaged" (p. 14). It has also been
suggested that ethnographies have done much in recent years to uncover the complexities of teaching and learning and may offer insights into OTL (Porter, 1995).

Ruiz-Primo, Ayala, & Shavelson (1999) evaluated science journals as an assessment tool to provide information about both student achievement and OTL in the science classroom. They proposed two indicators to evaluate OTL: (a) student exposure to science content based on teachers’ lesson plans and the researcher’s classroom observations, and (b) quality of teachers’ feedback to students’ performance as recorded in their science journals. To be of high quality, feedback needs to provide the student with specific information that helps students know how they are doing and how to improve (Wiggins, 1995). Also, feedback, according to Black (1993) must be descriptive; he noted that focusing on grading will under-emphasize learning.

What seems to be missing in the research literature are studies which identify and investigate OTL indicators at the classroom level which may not be under the control of the teacher. These indicators could include students’ attendance records, the number of school-based extra-curricular activities that excuse and pull students out of class, and the number of science classes that are cancelled when extra time is deemed necessary for reading and mathematics instruction. Other indicators that may be partially under the control of the teacher could include indicators such as the number of sick days a teacher takes and the number of days that teachers are not in class because of inservice days or professional leave days. Moreover, science classes may be compressed or only taught half a year because of the pressure teachers and administrators feel to have students perform well on the high stakes tests in
mathematics and English language arts. This practice occurs most often when students are in self-contained classrooms.

**Classroom Assessment Practices**

Overall, the research evidence that is available tends to divide itself along two views. The first assumes that research findings could be most useful if they delineated what criteria and standards should be evident in classroom practice (Cizek et al., 1996; McMorris & Boothroyd, 1993; Oescher & Kirby, 1990). Then once identified, these criteria could form the basis for teacher education. The second category looks at the issue from the teacher's perspective. Researchers have suggested that student acceptance and support of the testing model, the nature and quality of the information to be obtained from the test, external constraints, and the way in which the teacher intends to use test results may be as important, or more important in some cases, than the technical quality of the test in influencing CAPs (Morais & Miranda, 1996; Wilson, 1989).

**Success Bias**

Midwestern elementary and secondary school teachers (n=143) were surveyed by Cizek, Fitzgerald, & Rachor (1996) to collect information on several assessment-related practices. Interviews with the teachers provided additional insights into their practices. Study findings confirmed a weakness in the preparation of teachers in classroom assessment and grading. The authors suggested that additional assistance in meeting the Standards for Teacher Competence in Educational Assessment of Students is needed. A list of these competencies is found in Appendix A. It was noted by the authors that while most teachers claim that “trial and error” or “classroom
experience" informed their classroom assessment practices (CAPs), very few of the assessment practices studied were found to be related to years of teaching experience. For the teachers studied, their reported assessment practices were quite variable and unpredictable using factors such as grade, years of experience or gender. The one consistency that was reported in this study was termed a "success bias." Across the board, teachers appeared to structure their assessments and combine information in ways that were most likely to result in a higher grade for their students.

Planning for Assessment

All learners bring with them a range of experiences and knowledge. How and when science teachers address their students' prior knowledge and experiences as they engage in science instruction and assessment in their own classrooms is not well documented. Sanchez & Valcarcel (1999) investigated the planning practices of secondary science teachers. Neither the students' previous concept of the contents nor the suitability of the content to their cognitive capacity was taken into account by most teachers during planning.

In no case did any teacher think it necessary to set specific diagnostic tests or classroom activities which would reveal the preconceptions of the students on a particular topic for the benefit of either the teacher or the students themselves" (p. 503).

However, teachers did report giving consideration to the age or grade of the students in general when planning science units. An analysis of assessment issues revealed that the 27 teachers in the study viewed assessment as exclusively centered on what the students had learned as a result of instruction. The majority of the participants did not
consider assessment issues during planning and they postponed thinking about assessment until it was time to create an end of unit test.

Teacher-Made Tests

Purposes for Assessment

Although many studies relied on questionnaires and teacher interviews, Wilson (1989) included a collection of teachers' tests. The following data were collected for each test: title, date of use, number of students who completed it, the numbers of A's and F's earned, the median, total marks, the number of classes participating, a copy of the instrument, and an evaluation checklist indicating the purposes of the instrument (from 7 choices offered), an assessment of the achievement of the class in terms of teacher expectations, and any explanatory comments by the teacher concerning the context. It was reported that the assessments invariably served at least two purposes, if not more. And that,

Instruments under this system cannot be considered as discrete evaluations; they must fit into an emerging pattern resulting in conclusions of overall performance called grades, conclusions that involve normative judgment. Thus the professional testmaker's concern with clarity and singleness of purpose, a unitary index of reliability, and a view of validity based on the administration of a single instrument may not have much applicability in the complexity represented by this milieu (p. 141).

Other researchers (e.g., Stiggins & Conklin, 1991) have noted that teachers do not change their assessment methods as the purpose of their assessments change, which may indicate a lack of understanding about the relationship that exists between the method and purpose of assessment.

28
Item Format

Studies by Oescher & Kirby (1990) and McMorris & Boothroyd (1993) analyzed teacher-made tests in high school and junior high math and science classrooms, respectively. According to Oescher & Kirby (1990), the analyses pertaining to item formats in the high school study indicated that multiple choice, matching, and true-false format accounted for about 20%, 15%, and 5% of all items respectively. The researchers reported that only 4 essay items were found among the more than 1400 items examined. Teachers, however, perceived themselves writing far fewer short answer items and many more essay items than were observed. The McMorris and Boothroyd (1993) study included an overall rating of teachers’ tests of six dimensions made by a panel of seven judges. The dimensions included: (a) directions, (b) length, (c) presentation/appearance, (d) content sampling, (e) item construction, and (f) overall quality. Test quality for a teacher was estimated by averaging the ratings for the 30 evaluative items, three judges, and two tests. Average test quality on 30 evaluative items was 5.4 on 7-point semantic-differential scales. These teachers were awarded an overall score of B-. Exactly what the score means is open to interpretation; however, it is an improvement over the D or F that researchers (Carter, 1984; Fleming & Chambers, 1983; Gullickson, 1982; Schafer & Lissitz, 1987; Stiggins et al., 1989) assigned to teachers over the last 20 years.
**Teachers' Evaluation Criteria**

Morais and Miranda (1996) used teacher-made test questions and students' ability to grade other students' responses to investigate the relationship between how well students understood the teacher's evaluation criteria and student achievement. The authors concluded that many students did not understand the teacher's evaluation criteria. They noted that "Teachers awareness of this fact seems crucial and may contribute to the implementation of pedagogic practices leading to scientific literacy" (p. 622).

**Assessment Reform in the Science Classroom**

**Integration of Assessment and Learning**

Traditionally there has been a sharp distinction made between assessment and instruction in the classroom. The current call for reform in science assessment, as well as in instruction, has tended to blur the lines between them. According to Project 2061's blueprints: "Science activities and assessments can be mingled to provide increased opportunities for student learning". Supporting the idea of integrating assessment and learning, the National Research Council (1996) offered the following contemporary view of measurement theory and practice,

In this new view, assessment and learning are two sides of the same coin. The methods used to collect educational data define in measurable terms what teachers should teach and what students should learn. And when students engage in an assessment exercise, they should learn from it (p. 76).

How can students learn from classroom assessment tasks? Madaus and Kellaghan (1992) noted several possible mechanisms to explain how assessment might help promote student learning: (a) assessment focuses students' attention on particular
topics and skills, (b) formulating a response to test questions requires cognitive engagement on the part of the students, (c) assessment provides practice for students on material that helps to consolidate learning, and (d) assessment can provide feedback to the student that clarifies understanding or corrects misconceptions. Sebatane (1998) argued that "formative assessment, with the embedded concept of feedback, is the key factor in the promotion of classroom learning" (p. 123).

Focusing on the understanding of science as inquiry, Doran, Chan & Tamir (1998) offer strong support for the integral part of science assessment in the learning process.

As students carry out laboratory investigations that challenge them to increase their conceptual understanding, the distinction between assessment and instruction blurs into a seamless whole, and there is a near perfect alignment with standards (outcomes and expectations), programs (instruction), and assessments... If any of the three dimensions does not clearly link or interface with the other dimensions, then we compromise the fairness, credibility, validity, and utility of the assessment (p. 8).

**Non-traditional Assessment Methods**

Reflecting national interest in assessment reform, it is not surprising that researchers have focused on nontraditional forms of assessment, such as, performance assessments. Performance assessments have been touted as an instrument of reform (Resnick & Resnik, 1992; Wiggins, 1989). However, questions have been raised concerning the reliability and validity of these nontraditional forms of assessment. Research findings by Ruiz-Primo & Shavelson (1996) indicate that the news is both good and bad. In terms of reliability they reported that consistency of scores across raters can be positive, but that some important disagreements among individual raters may exist. Task sampling and occasion sampling may be confounded because
assessments are usually given on one occasion. "Simply put, students' performance varied from one occasion to the next, even though no further instruction or practice was received" (p. 1051). On the issue of validity, a large student by task by method interaction was reported (Baxter & Shavelson, 1994). Findings also indicated the need for large numbers of tasks to produce generalizable measures of achievement.

Many teachers think of performance assessments as anything that asks students to manipulate materials (Ruiz-Primo & Shavelson, 1996). Furthermore, teachers, in judging the quality of the assessments do not consider the task demands, the response formats, or the scoring system. The authors recommended that for performance assessment to be useful for teaching it needed to be linked directly to instructional units and have a well-designed scoring system that clearly reflects what students know and can do. The authors concluded that teachers who opt to use an activity-based curriculum in their classroom can administer performance-based assessments without major difficulties. Their findings supported the conclusion reached by Cowie & Bell (1995) who found that particular assessment practices (e.g., formative assessment) support particular views of learning (e.g., constructivist learning).

Kamen (1996) studied a fourth grade teacher as she implemented authentic assessment strategies in her science class. Authentic assessment requires students to apply scientific knowledge and reasoning to situations similar to those they will encounter outside the classroom or to situations that approximate how scientists do their work (NRC, 1996). The teacher was disappointed with her students' performance on science tests and hoped that aligning assessment with instruction might help her students to be more successful. This frustration with student test scores
became her motivation to change. Her attitude may reflect the notion of "success bias" reported by Cizek et al. (1996). Data were collected during the school year using extensive interviews and classroom observations. The researcher concluded that this teacher was successful at implementing a number of assessment strategies including: portfolios, creative drama, scrapbooks, meal maps, and student logs. However, after watching the teacher struggle with her own beliefs about teaching and assessment, Kamen (1996) noted,

It was surprising to me how much time it took before Virginia began to see the two [instruction and assessment] merge. She was completing a masters in a constructivist (Piagetian) early childhood program and participated in many discussions on integration, yet still perceived assessment as something outside of instruction.....she spent months with a feeling of dissonance despite administrative support, help from the university, and her own creative perceptiveness, and hard work (p. 870).

Early findings on the classroom use of nontraditional assessment suggest that changing the fundamental beliefs and instructional practices of teachers is much harder than assessment proponents thought (Aschbacher, 1993; Borko et al., 1993). And, when teachers do attempt to use performance assessments, they do not have strategies to incorporate the assessment results into their grading system (Borko et al., 1993).

Impact of Standards-Based Instruction

Only one study was found that focused on the impact of standards-based instruction on students' science achievement. Von Secker & Lissetz (1999) used a large-scale data base to investigate the impact of three instructional strategies recommended by NRC (1996) on student achievement. The strategies were: (a) increasing opportunities for laboratory inquiry, (b) increasing emphasis on critical

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thinking, and (c) reducing the amount of teacher-centered instruction. The authors argue that “even though data used in this study were collected 6 years prior to publication of the Standards, they provide compelling empirical evidence about associations of instructional strategies with science achievement and equity” (p. 1121). Their findings suggest that instruction matters. They reported that an emphasis in laboratory inquiry was invariably associated with higher achievement and more equitable achievement among all students. However, they also found that combinations of recommended strategies may have “the unintended consequence of contributing to greater achievement gaps among students with different demographic profiles” (p. 1110). For example, the combined effect of replacing an emphasis on teacher-centered instruction with one that focuses on developing critical thinking skills is expected to be associated with even greater gaps in achievement between boys and girls. Certainly their results are provocative and the authors caution readers about the dangers of drawing causal inference from correlational results.

Summary

The literature was searched to discover the answers to the following questions: What does research tell us about classroom assessment practices? Do teachers beliefs, attitudes, and/or views about assessment and learning influence the way they assess student learning? Is there evidence that national science standards and benchmarks are influencing how student learning of science is assessed? Is there evidence that student achievement increases when teachers use a standards-based approach to assessment? This summary will address those questions in the light of the research studies described in the review of literature.
Highlighting the relationship among beliefs, classroom practices, and change, Black and Wiliam (1993) suggested that the nature of each teacher’s beliefs about learning and the beliefs that teachers hold about the potential of all their pupils to learn are two basic issues that underlie some of the problems in changing teachers’ classroom practices. This perspective suggests that any serious effort to achieve the national goal of “science for all” involves paying attention to teachers’ views about how students learn science and the roles of both teachers and students in promoting science learning.

Collectively research on classroom assessment practices indicates that teachers and measurement specialists do not share the same knowledge base and that many teachers view assessment as being summative, separate and apart from teaching. However, the results of a few studies indicate that researchers have investigated and found useful non-traditional forms of assessment which offer a way for teachers to integrate teaching and assessment. And, that some teachers are successful at using these non-traditional forms of assessment in the classroom.

The research base on the influence of national standards on assessment is still in the early stages because the national standards and benchmarks were published less than ten years ago. Some might argue that it is too soon to study the influence of the standards on the teachers’ classroom practice. However, as the authors of Science for All Americans (1989) wrote, if people are still talking about and working toward science reform in ten years, we will have been successful.
MATERIALS AND METHODS

This research study was designed to identify the classroom assessment practices (CAPs) of middle school science teachers and to determine the extent to which science standards influence their CAPs using what has been called Sequential Quan/Qual Mixed Methods by Tashakkori and Teddlie (1998). In the Quan/Qual sequence, the investigator starts with a quantitative method and then proceeds with a follow-up qualitative study. This study was conducted in two phases. In Phase I, the researcher mailed questionnaires to 450 middle school (grades 5-8) teachers in seventeen parishes in the state of Louisiana to obtain information about their classroom assessment practices. Of these, 197 (44%) were returned. In Phase II, nine middle school teachers in eight departmentalized classrooms, two classes at each grade, participated in a qualitative study designed to study the classroom assessment practices of middle school (grades 5-8) science teachers.

The data collection techniques used in this study reflect both quantitative and qualitative methodologies. The quantitative data collection technique used in this study was the self-report questionnaire: Classroom Assessment Practices Questionnaire (CAPQ). Self-report measures have a major disadvantage of being affected by the person who is reporting (Tashakkori & Teddlie, 1998); teachers may not be consciously cognizant of their instructional practices and so may be unable to describe fully what they do (Good & Brophy, 1973). Therefore, researchers are usually advised to discuss reported practices with teachers or to validate teachers' reported practices via observation (Freeman & Porter, 1989; Stodolsky, 1989). For this reason, and to probe more deeply into teachers' CAPs, the investigator conducted
follow-up observations and interviews with a sub sample of teachers (Bogdan & Biklen, 1982).

The multiple data collection methods used in this study included a mail questionnaire (450 mailed, 197 returned), classroom observations by the researcher (54 hours), face-to-face teacher interviews (18 interviews), and analysis of classroom assessment documents (8 documents).

Phase I

Participants

Participants in this study included middle school science teachers who (a) taught at least one class of fifth, sixth, seventh or eighth grade science, (b) were employed to teach in a public school for the school year 1999-2000, (c) were employed by a school district having 51-75% of their student body participating in the federal free or reduced lunch program, and (d) had a superintendent who permitted the researcher to mail questionnaires to the teachers in his or her district. Questionnaires were mailed to 450 teachers, 197 of those returned were used in the study. Some of the questionnaires were returned unopened, others were returned because teachers had retired, moved or were no longer employed.

Sampling Technique and Sample Size

According to the 1997-1998 Louisiana Progress Profiles State Report, published by the Louisiana Department of Education (1999), the state of Louisiana has 66 independent school districts. One of these was selected as the site of the qualitative study. Because the researcher works in the district and has access to the teachers, these individuals represent a sample of convenience (Tashakkori & Teddlie, 1998).
Of interest to this researcher was whether the teachers being observed in Phase II of the project used assessment practices that were similar to the practices used by teachers in other Louisiana school districts. Because the classroom teaching and assessment practices of teachers is partly driven by the students in the classroom, the researcher decided to control for both grade and poverty level. In order to get a more homogeneous sample, the decision was made to match school districts based on poverty level and to match teachers based on grade currently taught. Poverty level was determined using the percentage of student participation in the federal free or reduced lunch program for the following reasons: (a) research has shown that child poverty affects student achievement (Biddle, 1997) and (b) students' eligibility for free or reduced-price lunches is frequently used as an indirect indicator of child poverty (Biddle, 1997; DOE, 1997).

Using the NAEP data set concerned with science achievement in 1996, Biddle (1997) reported that levels of school funding and rates of child poverty in the U.S. are strongly associated with differences in eighth grade science achievement among both districts and states. According to his findings, the proportion of state-level achievement variance predicted by funding and poverty is 53%.

Child poverty has but one type of effect at the level of the individual student: it interferes with that person's achievement. At the level of the school and district, however, it can generate effects in two ways: by affecting the individual student and by creating a collective "environment of poverty" within the school or community (p. 12).

It was determined, using the state student information system (SIS), that 74% of the students in the parish selected as the site of the qualitative study, participated in the lunch program. Next, using the 1997-1998 Louisiana Progress Profiles State
Report (DOE, 1999) all school districts having 51-75% of their student body participating in the federal free or reduced lunch program were identified (see Appendix B). A total of 40 school districts were identified as having 51-75% of their students receiving free or reduced lunch. A letter (Appendix C) was sent to the superintendents of these school districts requesting permission to contact the personnel director and to survey their middle school (grades 5-8) teachers. Written permission was received from 24 of the superintendents. Four of the superintendents refused to participate, and the remaining superintendents did not respond.

Faxes were then sent to the personnel directors (Appendix D) of the 24 parishes requesting a list of the 5th, 6th, 7th, and 8th grade teachers, by school, who were teaching at least one science class during the 1999-2000 school year. A follow up request was faxed to those directors not responding within two weeks and a follow up phone call was made one week later. Teacher contact lists were received from 17 of the 24 school districts.

A sampling frame was made by compiling the lists from the 17 participating parishes. A simple random sample of teachers was selected from this list. The individual sampling was accomplished using a random numbers table. The number of teachers, selected according to the formula suggested by Mosser and Kalton (1972), totaled 450.

**Development of the Questionnaire**

The mail questionnaire, Classroom Assessment Practices Questionnaire (CAPQ), (Appendix E) addressed a broad range of issues related to classroom practices and the vision of science learning and assessment embodied in science
reform documents (e.g., AAAS, 1993; NRC, 1996). Major themes included classroom assessment, opportunity to learn, availability and use of science standards, teachers' views on how students learn, the teacher's role in learning and the student's role in learning. The questionnaire also contained items related to teacher background and professional development.

The CAPQ was field tested on a group (n=25) of science teachers who attended a Louisiana Systemic Initiative Program (LaSIP) assessment workshop in August, 1998, in Robert, Louisiana. These teachers were asked to indicate any problems that they encountered with the clarity or format of the instrument. Their suggestions were compiled and appropriate changes were made.

The mail questionnaire contained 25 questions. Most of the CAPQ questions, 18 out of 25, were presented in a closed format. For example, item 1 asked teachers to indicate on a five-point Likert scale how strongly each of 16 factors influenced their decisions to select or construct a particular type of assessment. Some items offered teachers a predetermined set of options and then asked the teacher to select one option or to select multiple options. For example, in item 4, teachers were directed to darken only one choice while in item 3 teachers were directed to darken all that apply. Several items permitted respondents to write in other choices. The remaining six questions collected information about teachers' use of standards, teachers' understanding of the learning process, and teachers' views on teachers' and students' roles in learning, these items required respondents to construct their own responses.
Data Collection and Analysis

During Phase I, the data were collected by mail questionnaire as shown in Appendix E. The CAPQ was sent with an explanatory cover letter (Appendix F) to 450 randomly selected middle school science teachers, employed to teach science for the school year 1999-2000, in 17 parishes in Louisiana. A postage-paid, self-addressed envelope was also included for returning the questionnaire. The questionnaires were numbered to identify respondents and non-respondents for follow-up purposes only. If the questionnaire was not returned within three weeks, a reminder was faxed to the school. At the end of the next two-week period, a second questionnaire was sent to non-respondents. Two weeks later an additional fax was sent to the school. Teachers not returning the questionnaire and those refusing to participate in the study were replaced using the list that was generated from the random numbers table until the second questionnaire mailing. However, following the second mailing no more teachers were replaced. A total of 197 usable questionnaires were returned.

The type of data collected determined the type of analysis used (Tashakkori & Teddlie, 1998). Quantitative data were analyzed using the teacher as the unit of analysis. Descriptive statistics were used to analyze the responses to the CAPQ.

Phase II

Participants

Teachers in Phase II indicated an interest in and a willingness to participate in the study by completing and returning a form (Appendix F) that was included with the questionnaires sent to middle school teachers teaching in the parish selected as the site
of the qualitative study. The researcher contacted each of the nine teachers who returned the forms to schedule the first interviews. All of the nine teachers who volunteered participated in the study. Two of the teachers team taught a science class; one was a certified elementary teacher and the other was not a certified teacher. All of the remaining teachers were certified in elementary education and worked in departmentalized classrooms. Three of the teachers had participated in at least one of the university summer courses that were cosponsored by the Louisiana Systemic Initiative Program (LaSIP). These courses were specifically designed for middle school teachers to help them use more effective science teaching strategies to implement the new national and state science standards. The participants ranged in teaching experience from one year to 27 years. All of the teachers were female; eight were Caucasian and one was African-American. The number of students per classroom ranged from 13 to 27 students.

Data Collection and Analysis

The qualitative data focused on understanding how middle school teachers’ classroom assessment practices are influenced by national and state science standards and to determine whether teachers are providing students with the opportunity to learn the materials in national science standards documents. The qualitative strategies included classroom observations (54 hours), teacher interviews (18 interviews), and document analysis (8 documents). The qualitative data were analyzed before the researcher analyzed the data collected with the mail questionnaire. Doing the analysis in this order prevented the researcher from being influenced by the quantitative data.
Classroom Observations

Observation has been widely and successfully applied to educational research and to the study of CAPs and was found to be appropriate for capturing a broad range of practices that teachers use (Stiggins, 1992). Moreover, observation enabled the researcher to study assessment practices that are interactive in nature, such as oral questioning and teacher feedback to students. The researcher did not enter the classroom with a structured set of questions or any preliminary restrictions as to what would constitute relevant data. Rather, the investigator observed in the classrooms, taking notes on all the activities that occurred, allowing the content, structure, and impact of assessment practice to emerge from the accumulation of teacher and student interactions witnessed and interpreted in the context of these dynamic classroom situations (Stiggins & Conklin, 1992).

The researcher took notes during observations, but a video camera was not used because the district has a policy that prohibits taking videos or pictures of special education students. Because most special education students are mainstreamed into science classes, videotaping classes would have been problematic. According to the process recommended by Glesne and Peshkin (1992), descriptive notes were made and completed during the observation. These notes recounted the actions of the participants, not how the observer interpreted the actions. Because there were no policies against audio taping classes, an audio tape was made during each class to supplement the researcher's notes.

Data collected were initially analyzed keeping in mind how the data would be most useful in describing the classroom assessment practices of the teachers in the
study. As was noted in the introduction, “assessment is a systematic, multistep process involving the collection and interpretation of educational data” (NRC, 1996, p.77). The four components of the assessment process include: (a) data use (e.g. plan teaching, guide learning, calculate grades), (b) data collection (e.g. to describe and quantify student achievement and attitude), (c) methods to collect data (e.g. paper and pencil testing, performance testing, interviews), and (d) users of data (e.g. teachers, students, parents). Patton (1990) pointed to the need for a researcher to have some initial framework for managing the large amount of data collected during fieldwork. He identified several options researchers could use for data management including: chronology, key events, various settings, people, processes, and issues. Guided by the definition of assessment as a process and Patton’s (1990) support for using processes for data management, the researcher used the idea of assessment as a process as a framework for data collected. Initial analysis yielded information about what characteristic was assessed and what assessment methods were used to collect the data. Further iterations were made to determine (a) if the teachers in this study used different types of assessment to measure student achievement, attitude, and student projects and (b) if the collection processes used to collect data were consistent with the purpose of the assessment.

**Teacher Interviews**

Each teacher was interviewed twice. The first teacher interview focused on the logistics of scheduling classroom observations and the selection of the science unit to be taught. The second interviews focused on clarifying events that occurred during classroom observations and asking teachers how they used national or state science
standards when planning for instruction and assessment. During the first interview, the investigator explained to each teacher that the research study was an exploratory study to investigate how teachers determine what their students know and are able to do as a result of classroom instruction. During this interview, each teacher was asked to sign a consent form (Appendix G). The first interview was informal and in most cases took less than 30 minutes. The second interviews were tape-recorded and transcribed by a typist other than the researcher. To maintain confidentiality each teacher was assigned a code and these codes were used to identify the tapes for the typist.

Patton (1990) described three variations in qualitative interviewing (a) the informal conversational interview, (b) the general interview guide approach, and (c) the standardized open-ended interview. The informal conversational interview was used in this study because it offered the most flexibility. Most of the questions flowed from what was observed in the classroom. The data gathered were different for each person interviewed. However, because the two-fold purpose of the study was to identify the classroom assessment practices of teachers and to determine the influence national and state science standards on their practices, frequently the topics addressed in the interviews overlapped.

Data were analyzed using cross-case analysis. This means grouping together answers from different people to analyze different perspectives on the central issues (Patton, 1990). In this study the central issue was the influence of national and state science standards on the teachers' CAPs. Interviewing and observing teachers across multiple grade levels (5th, 6th, 7th, and 8th) provided the researcher with a rich
opportunity to study the classroom assessment practices of middle school teachers. Also by combining observations and interviewing techniques the researcher was able to check with the teachers to verify the intent of their assessment behaviors.

**Document Analysis**

The analysis of classroom assessment documents is a recognized method of data collection and can provide valuable evidence of the extent to which teachers are influenced by science reform efforts. Therefore, eight written classroom assessment documents used by the classroom teachers were collected. These tests were used by the teachers to determine what their students knew and were able to do as a result of instruction received during the time the observations were made. These documents were analyzed using the draft form of the Assessment Analysis procedure (see Appendix H) developed by members of Project 2061 (personal communication, Kulm, June 27, 1997).

The Assessment Analysis has four components: (a) preliminary analysis, (b) content alignment, (c) format analysis and, (d) a profile of the test or test item. During the preliminary evaluation the task is to identify a collection of benchmarks or standards that appear to be central to the test. These standards and benchmarks are then ranked from high to low to give a rough picture of how well they are addressed.

The content alignment is a more rigorous examination of the link between the assessment items and the standards and benchmarks. It proceeds in two steps. In step 1 attention is given to the match between the individual test items and the individual skills and specific ideas in the benchmark or standard. Issues of substance, sophistication and the part/whole relationship of the items to the standards and
benchmarks are addressed. In step 2 the assessment is surveyed as a whole to estimate the degree of overlap between its content and the standards and benchmarks. During this part of the analysis the extent to which the standards and benchmarks are covered and identification of extraneous content are addressed.

The purpose of the format analysis is to estimate how well a test item addresses the central benchmarks from the perspective of what is known about student learning and effective assessment. The criteria for making decisions were derived by members of Project 2061 from research on assessment and from experience in the classrooms and testing. The four criteria are: (a) fit of item format, (b) important ideas, (c) context and fairness, and (d) usefulness.

The profile is a summary of the main features of the subject material. The profile includes the conclusions reached with regard to 1) the treatment of key benchmarks, and 2) the over-all character of the material. While the profile includes judgments regarding how well standards and benchmarks are treated, it does not conclude with an over-all rating (Project 2061, Assessment Analysis, draft copy, 1997).
RESULTS

Data for this two part study were collected from four sources: mail questionnaires (197, 44%, returned), face to face teacher interviews (18 interviews), document analysis (8 test documents), and classroom observations (54 hours). In Phase I of the study 197 teachers returned completed questionnaires; these teachers will be referred to as respondents. In Phase II of the study, nine teachers participated in the qualitative study; these teachers will be referred to as participants. Following a description of the respondents, both quantitative and qualitative results will be presented as they relate to each question. The data were collected to answer the research questions posed at the beginning of this study:

1. What are the classroom assessment practices (CAPs) of middle school science teachers?

2. To what extent do the national or state science standards influence CAPs?
   a. Are teachers providing students with the opportunity to learn the material in national or state content standards?
   b. Do teachers views on science teaching and learning support the vision of science learning set forth in science reform documents?

Demographics of Respondents

Complete and usable questionnaires were received from 197 middle school teachers. In this sample, 84% (165) of the teachers were female and 16% (31) were male. As shown in Table 4.1, 95% of the respondents (186 out of 197), were certified teachers, 5% (9) non-certified, and 1% (2) did not respond to this question. Of the
186 teachers who were certified, 151 of them were certified in elementary education, 35 in secondary education certification, and 21 held science certification.

Table 4.1

Respondents’ Area of Certification (N = 197)

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>%</th>
<th>n</th>
</tr>
</thead>
<tbody>
<tr>
<td>Teacher Certification</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Certified</td>
<td>95</td>
<td>186</td>
</tr>
<tr>
<td>Elementary Education</td>
<td>151</td>
<td></td>
</tr>
<tr>
<td>Secondary (science)</td>
<td>21</td>
<td></td>
</tr>
<tr>
<td>Secondary (not science)</td>
<td>14</td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td>14</td>
<td></td>
</tr>
<tr>
<td>Not Certified</td>
<td>5</td>
<td>9</td>
</tr>
<tr>
<td>No Response</td>
<td>1</td>
<td>2</td>
</tr>
</tbody>
</table>

Responses indicated that these teachers represented a wide range of teaching experience as shown in Table 4.2. Nine percent of the teachers reported teaching between 1-0 years, 18% between 2-5 years, 21% between 6-10 years, 15% between 11-15 years, 11% between 16-20 years, 25% reported more than 21 years of teaching experience. One teacher did not respond to the question. When asked to indicate years of science teaching experience, 14% reported teaching science between 1-0 years, 25% between 2-5 years, 23% between 6-10 years, 15% between 11-15 years, 9% between 16-20 years, 13% reported more than 21 years of science teaching experience. One teacher did not respond to the question.
Table 4.2

Respondents’ Years of Teaching Experience and Years of Science Teaching Experience (N = 197)

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>%</th>
<th>n</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Years of Teaching Experience</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0-1</td>
<td>9</td>
<td>18</td>
</tr>
<tr>
<td>2-5</td>
<td>18</td>
<td>36</td>
</tr>
<tr>
<td>6-10</td>
<td>21</td>
<td>41</td>
</tr>
<tr>
<td>11-15</td>
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<td>49</td>
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<td>1</td>
</tr>
<tr>
<td><strong>Years of Science Teaching Experience</strong></td>
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<td></td>
</tr>
<tr>
<td>0-1</td>
<td>14</td>
<td>27</td>
</tr>
<tr>
<td>2-5</td>
<td>25</td>
<td>50</td>
</tr>
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<td>6-10</td>
<td>23</td>
<td>46</td>
</tr>
<tr>
<td>11-15</td>
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<td>29</td>
</tr>
<tr>
<td>16-20</td>
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<td>18</td>
</tr>
<tr>
<td>21+</td>
<td>13</td>
<td>26</td>
</tr>
<tr>
<td>No response</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

Data were also obtained regarding school location, class size, and class organization. Ninety-four percent of the teachers reported working in rural or town and small city schools as indicated in Table 4.3. Eighty three percent of the respondents worked in schools whose populations were between 100 and 750 students. The majority, sixty-one percent of the teachers reported class sizes of 25 and below and 33% of the teachers reported class sizes of 26-30 students. Thirty-five percent of the teachers taught self-contained classes which meant that they taught the same students all day long and were responsible for teaching all core subjects. The remaining teachers, 65%, taught more than one class of students during the day, some taught only science and others taught science and other subjects. Forty-four percent
Table 4.3

Respondents' School and Class Demographics (N = 197)

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>%</th>
<th>n</th>
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</thead>
<tbody>
<tr>
<td><strong>School Location</strong></td>
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<tr>
<td>Rural</td>
<td>50</td>
<td>98</td>
</tr>
<tr>
<td>Town or small city</td>
<td>44</td>
<td>86</td>
</tr>
<tr>
<td>Suburban</td>
<td>5</td>
<td>10</td>
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<tr>
<td>Urban</td>
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<td>2</td>
</tr>
<tr>
<td>No Response</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td><strong>School Population</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>100 or less</td>
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<td>5</td>
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<tr>
<td>101-500</td>
<td>54</td>
<td>107</td>
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<td>501-750</td>
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<td>57</td>
</tr>
<tr>
<td>751-1000</td>
<td>8</td>
<td>16</td>
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<tr>
<td>1001-1500</td>
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<td>10</td>
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<tr>
<td>1501-2000</td>
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<td>1</td>
</tr>
<tr>
<td>No Response</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td><strong>Class Size</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15 or less</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>16-20</td>
<td>14</td>
<td>28</td>
</tr>
<tr>
<td>21-25</td>
<td>45</td>
<td>89</td>
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<tr>
<td>26-30</td>
<td>33</td>
<td>65</td>
</tr>
<tr>
<td>31-35</td>
<td>5</td>
<td>10</td>
</tr>
<tr>
<td>No Response</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td><strong>Class Organization</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Self-contained</td>
<td>35</td>
<td>69</td>
</tr>
<tr>
<td>Departmentalized</td>
<td>44</td>
<td>86</td>
</tr>
<tr>
<td>Team teach</td>
<td>10</td>
<td>20</td>
</tr>
<tr>
<td>Block schedule</td>
<td>7</td>
<td>13</td>
</tr>
<tr>
<td>Other</td>
<td>4</td>
<td>7</td>
</tr>
<tr>
<td>No Response</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td><strong>Highest Grade Currently Teaching</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fifth</td>
<td>38</td>
<td>74</td>
</tr>
<tr>
<td>Sixth</td>
<td>25</td>
<td>49</td>
</tr>
<tr>
<td>Seventh</td>
<td>16</td>
<td>32</td>
</tr>
<tr>
<td>Eighth</td>
<td>20</td>
<td>39</td>
</tr>
</tbody>
</table>
taught in a departmentalized situation and 10% were part of a team. Only 7% of the teachers reported teaching on a block schedule.

When asked to indicate the grade being taught at the time of the study, teachers reported teaching one to three different grades. Therefore, the responses were grouped based on the highest grade (fifth, sixth, seventh or eighth grade) the teacher was currently teaching. Thirty-eight percent of the teachers who responded taught fifth grade, 25% of the teachers taught sixth grade as the highest level, 16% of the teachers taught seventh grade as the highest level and 20% of the teachers taught eighth grade.

Classroom Assessment Practices of Middle School Science Teachers

As was noted in the introduction, assessment is a systematic, multistep process involving the collection and interpretation of educational data to make decisions and take action based on the data (NRC, 1996). Data used to identify classroom assessment practices were collected from five sources: questionnaire, classroom observations, teacher interviews, teachers’ lesson plans, and document analyses of teacher-made tests. The analyses of the information obtained from these sources are described in this section.

Reported by Teachers in the Questionnaire

Match Between Achievement Targets and Assessment Methods

Question 5 in the CAPQ asked teachers to match assessment targets with the methods they used to determine whether or not students achieved the target. Data in Table 4.4 indicate a wide range of ‘matches’ used by middle school science teachers. Six matches were identified as being used by over 50% of the teachers. These 6 matches were grouped based on the assessment method and included: (a) using essay
questions to measure students' ability to reason and solve problems (51%) and to assess students' mastery of science knowledge and understanding (52%); (b) using performance assessment to evaluate instructional units (51%), to assess students' science process skills (62%), and to assess students' ability to create tangible products (65%); and, (c) using personal communication to assess students' attitudes and interests (81%).

Another way to look at the data is to focus on the assessment targets and identify the method used by the largest number of teachers in this study. This strategy revealed the following additional matches: (a) when diagnosing strengths and weaknesses of individual students 45% of the teachers reported using performance assessments, (b) when diagnosing groups needs 44% reported using performance assessment, (c) when determining student progress toward information literacy skills 39% reported using essay questions, and (d) when determining student progress toward foundation skills 42% reported using selected responses.

According to Stiggins (1992; 1997) although you can assess most types of student learning targets by most methods, there are some more and less efficient ways to do it. For example, if you want to know if a student can determine the density of an object, give him or her an object and access to lab equipment and supplies and then give the student time to determine the density of the object. But if you want the student to explain the relationship of mass and volume to density, ask him or her to tell you or to write it down. A modified version of Stiggins' (1992) original model is used to examine the appropriateness of the matches between achievement targets and assessment methods reported by teachers in the CAPQ (see Table 4.5).
Table 4.4

Matching Achievement Targets to Assessment Methods (N=197)

<table>
<thead>
<tr>
<th>Achievement Target</th>
<th>Assessment Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diagnosing strengths and weaknesses of individual students</td>
<td>DK % (n)</td>
</tr>
<tr>
<td></td>
<td>DA % (n)</td>
</tr>
<tr>
<td></td>
<td>SR % (n)</td>
</tr>
<tr>
<td></td>
<td>EQ % (n)</td>
</tr>
<tr>
<td></td>
<td>PA % (n)</td>
</tr>
<tr>
<td></td>
<td>PC % (n)</td>
</tr>
<tr>
<td></td>
<td>ST % (n)</td>
</tr>
<tr>
<td>Diagnosing group needs</td>
<td>1(1)</td>
</tr>
<tr>
<td></td>
<td>3(5)</td>
</tr>
<tr>
<td></td>
<td>29(58)</td>
</tr>
<tr>
<td></td>
<td>24(47)</td>
</tr>
<tr>
<td></td>
<td>45(88)</td>
</tr>
<tr>
<td></td>
<td>38(74)</td>
</tr>
<tr>
<td></td>
<td>37(73)</td>
</tr>
<tr>
<td>Evaluating an instructional unit</td>
<td>2(3)</td>
</tr>
<tr>
<td></td>
<td>8(16)</td>
</tr>
<tr>
<td></td>
<td>23(45)</td>
</tr>
<tr>
<td></td>
<td>12(23)</td>
</tr>
<tr>
<td></td>
<td>44(86)</td>
</tr>
<tr>
<td></td>
<td>32(63)</td>
</tr>
<tr>
<td></td>
<td>25(49)</td>
</tr>
<tr>
<td>Measuring students ability to reason and solve problems</td>
<td>2(3)</td>
</tr>
<tr>
<td></td>
<td>3(5)</td>
</tr>
<tr>
<td></td>
<td>47(92)</td>
</tr>
<tr>
<td></td>
<td>28(56)</td>
</tr>
<tr>
<td></td>
<td>51(100)</td>
</tr>
<tr>
<td></td>
<td>19(37)</td>
</tr>
<tr>
<td></td>
<td>7(9)</td>
</tr>
<tr>
<td>Determining student progress toward information literacy skills</td>
<td>7(11)</td>
</tr>
<tr>
<td></td>
<td>5(9)</td>
</tr>
<tr>
<td></td>
<td>32(62)</td>
</tr>
<tr>
<td></td>
<td>39(76)</td>
</tr>
<tr>
<td></td>
<td>27(53)</td>
</tr>
<tr>
<td></td>
<td>23(46)</td>
</tr>
<tr>
<td></td>
<td>11(22)</td>
</tr>
<tr>
<td>Determining student progress toward foundation skills</td>
<td>4(8)</td>
</tr>
<tr>
<td></td>
<td>4(7)</td>
</tr>
<tr>
<td></td>
<td>42(83)</td>
</tr>
<tr>
<td></td>
<td>24(48)</td>
</tr>
<tr>
<td></td>
<td>39(77)</td>
</tr>
<tr>
<td></td>
<td>18(36)</td>
</tr>
<tr>
<td></td>
<td>19(38)</td>
</tr>
<tr>
<td>Assessing students science process skills</td>
<td>3(6)</td>
</tr>
<tr>
<td></td>
<td>3(6)</td>
</tr>
<tr>
<td></td>
<td>22(44)</td>
</tr>
<tr>
<td></td>
<td>21(41)</td>
</tr>
<tr>
<td></td>
<td>62(122)</td>
</tr>
<tr>
<td></td>
<td>25(49)</td>
</tr>
<tr>
<td></td>
<td>6(11)</td>
</tr>
<tr>
<td>Assessing students ability to create tangible products</td>
<td>3(6)</td>
</tr>
<tr>
<td></td>
<td>9(18)</td>
</tr>
<tr>
<td></td>
<td>18(35)</td>
</tr>
<tr>
<td></td>
<td>18(36)</td>
</tr>
<tr>
<td></td>
<td>65(127)</td>
</tr>
<tr>
<td></td>
<td>20(40)</td>
</tr>
<tr>
<td></td>
<td>5(10)</td>
</tr>
<tr>
<td>Assessing students mastery of science knowledge and understanding</td>
<td>1(2)</td>
</tr>
<tr>
<td></td>
<td>1(2)</td>
</tr>
<tr>
<td></td>
<td>34(66)</td>
</tr>
<tr>
<td></td>
<td>52(102)</td>
</tr>
<tr>
<td></td>
<td>46(90)</td>
</tr>
<tr>
<td></td>
<td>18(36)</td>
</tr>
<tr>
<td></td>
<td>17(34)</td>
</tr>
<tr>
<td>Assessing students attitudes and interests</td>
<td>1(2)</td>
</tr>
<tr>
<td></td>
<td>4(8)</td>
</tr>
<tr>
<td></td>
<td>16(31)</td>
</tr>
<tr>
<td></td>
<td>16(31)</td>
</tr>
<tr>
<td></td>
<td>8(16)</td>
</tr>
<tr>
<td></td>
<td>81(159)</td>
</tr>
<tr>
<td></td>
<td>1(2)</td>
</tr>
</tbody>
</table>

Note. DK = don’t know what this means, DA = don’t assess this in my classroom, SR = selected response, EQ = essay questions, PA = performance assessment, PC = personal communication, ST = standardized tests.
Table 4.5

**Appropriateness of Matches Achievement Targets to Assessment Methods**

<table>
<thead>
<tr>
<th>Achievement Target</th>
<th>Selected Response</th>
<th>Essay Assessment</th>
<th>Performance Assessment</th>
<th>Personal Communication</th>
</tr>
</thead>
<tbody>
<tr>
<td>Knowledge</td>
<td>X</td>
<td>X (T)</td>
<td>O</td>
<td>P</td>
</tr>
<tr>
<td>Reasoning</td>
<td>P</td>
<td>X (T)</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Skills</td>
<td>O</td>
<td>O (T)</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>—information literacy</td>
<td>(T)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>—foundation literacy</td>
<td>(T)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>—science process</td>
<td>(T)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Products</td>
<td>O</td>
<td>P</td>
<td>X (T)</td>
<td>X</td>
</tr>
<tr>
<td>Attitudes &amp; Interests</td>
<td>X</td>
<td>P</td>
<td>P</td>
<td>X (T)</td>
</tr>
</tbody>
</table>

**Note.** X = good match; P = partial match; O = not a good match; (T) = the majority of teachers reported using these matches

**Teacher Reported Activities Related to Assessment**

Teachers were asked how often they (a) used assessment to find out what students knew before or during a unit, (b) embedded assessment in regular class activities, and (c) read or commented on reflections students wrote in journals or notebooks. Teachers were also asked how often their students (a) worked on portfolios, (b) took tests (multiple choice, fill in the blank, matching), (c) took tests requiring open-ended responses (descriptions, explanations), and (d) engaged in performance tasks for assessment purposes.

Table 4.6 shows the frequency of selected activities reported by teachers in the CAPQ. When asked how often they used assessment before or during a unit of instruction, 16% of the teachers reported assessing almost every class period, 34% of
Table 4.6

Teacher Reported Activities Related to Assessment

<table>
<thead>
<tr>
<th>CAPQ item</th>
<th>N</th>
<th>R</th>
<th>S</th>
<th>O</th>
<th>A</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>% (n)</td>
<td>% (n)</td>
<td>% (n)</td>
<td>% (n)</td>
<td>% (n)</td>
<td>% (n)</td>
</tr>
<tr>
<td><strong>Teacher Activities</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Use assessment to find out what students know before or during a unit.</td>
<td>6(12)</td>
<td>17(34)</td>
<td>26(52)</td>
<td>34(66)</td>
<td>16(32)</td>
<td>99(196)</td>
</tr>
<tr>
<td>Embed assessment in regular class activities.</td>
<td>4(7)</td>
<td>7(13)</td>
<td>30(59)</td>
<td>42(82)</td>
<td>14(28)</td>
<td>96(189)</td>
</tr>
<tr>
<td>Read/comment on reflections students write in journals or notebooks.</td>
<td>16(31)</td>
<td>22(44)</td>
<td>29(58)</td>
<td>20(40)</td>
<td>11(21)</td>
<td>98(194)</td>
</tr>
<tr>
<td><strong>Student Activities</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Write reflections in a notebook or journal</td>
<td>19(37)</td>
<td>18(36)</td>
<td>28(56)</td>
<td>19(38)</td>
<td>11(22)</td>
<td>96(189)</td>
</tr>
<tr>
<td>Work on portfolios</td>
<td>36(70)</td>
<td>22(44)</td>
<td>21(41)</td>
<td>12(23)</td>
<td>6(11)</td>
<td>96(189)</td>
</tr>
<tr>
<td>Take tests (multiple choice, fill-in-the-blank, matching)</td>
<td>1(2)</td>
<td>1(2)</td>
<td>28(56)</td>
<td>51(100)</td>
<td>17(33)</td>
<td>98(193)</td>
</tr>
<tr>
<td>Take tests requiring open-ended responses (descriptions, explanations)</td>
<td>2(4)</td>
<td>6(12)</td>
<td>34(67)</td>
<td>46(90)</td>
<td>10(20)</td>
<td>98(193)</td>
</tr>
<tr>
<td>Engage in performance tasks for assessment purposes</td>
<td>5(9)</td>
<td>15(29)</td>
<td>41(80)</td>
<td>27(54)</td>
<td>8(16)</td>
<td>95(188)</td>
</tr>
</tbody>
</table>

**Note.** N= never, R= rarely (a few times a year), S=sometimes (once or twice a month, O=often (once or twice a week), A=all or almost all classes

the teachers reported at least once or twice a month, 26% once or twice a week, and 23% reported never or rarely assessing students before or during a unit. One item referred to the use of embedded assessments. Forty-two percent of the teachers
reported embedding assessments in regular class activities once or twice a week, 14% almost every class period, 30% reported once or twice a month, and 11% of the teachers reported never or rarely using embedded assessments. In reporting the frequency with which they read or commented on students’ journal entries, 29% of these teachers reported at least once a month, 29% reported once or twice a week, 11% daily, and 38% indicated never or rarely reading and commenting on student journals.

The remaining five items shown in Table 4.6 focused on the frequency of selected student activities, reported by teachers, as an indicator of classroom assessment practices. One item asked how often students wrote reflections in journals or notebooks. Teachers’ responses indicated that 37% of the students never or rarely wrote reflections, 28% wrote reflections once a month, 19% reported once a week journaling, and 11% of the teachers asked students to write reflections daily. In reporting students’ work on portfolios, 58% of the teachers responded that students worked rarely, 21% once or twice a month, 12% reported students worked once or twice a week, and 6% indicated that students worked on portfolios daily.

Teachers were also asked how often students engaged in tests that required selected responses (multiple choice, fill-in-the-blank, matching), open-ended responses, and performance tasks. When asked specifically about the frequency with which they used particular test formats, 51% of teachers reported that students engaged in selected response tests once a week, 28% engaged students in selected response tests once a month, 17% used selected response tests on a daily basis and 2% of the teachers never or rarely used selected response tests. Responses to the item asking about the frequency of use for open-ended test items indicated that 46% of the

57
teachers reported using tests requiring open-ended responses with their students at least once or twice a week, 34% once or twice a month, 10% almost every class, and 8% reported never or rarely having students take tests requiring open-ended responses. Teachers reported using performance tasks less frequently than either selected response or open-ended items. Forty-one percent of the teachers reported engaging their students in a performance task at least once or twice a month, 27% once or twice a week, 8% reported using performance tasks almost daily, and 20% of the teachers rarely or never used performance tasks in the classroom.

**Observed in the Classroom**

**Identifying Achievement Targets and Assessment Methods**

In this section, teachers' classroom assessment practices observed in the classroom are reported. Table 4.7 identifies the achievement targets and the assessment methods used by the middle school teachers in this study. The major categories of achievement targets identified in a cross-case analysis included student achievement, student attitudes and student products. Two of these categories are subdivided and include only those instances which were observed in the classroom by the researcher. Category I, Student Achievement, is divided into science content and science processes. When assessing science content teachers used oral questions and answers, teacher demonstrations, and class discussions. Teacher-directed activities seemed to dominate the assessment of science content. However, a notable exception to this was the use of concept mapping (albeit by only one teacher) to assess knowledge structure. Concept mapping in this instance was clearly a student-centered activity. When assessing science processes, teachers used more student-centered
assessment methods. For example, a class of fifth grade students recorded their predictions in an activity log at the beginning of an activity. They also recorded observations made over a period of several days and then compared their observations to their predictions to see if the results of the activity supported their predictions.

Another way to assess process skills used by teachers in this study was to have students perform experiments, record their data, and then communicate their results to the teacher and/or class. Two of the teachers organized small groups of students to carry out science experiments. After collecting and analyzing their data, group members submitted written reports to the teacher and oral reports to their peers. These teachers' assessments focused on students' ability to make predictions, draw conclusions and communicate their results in a variety of ways (i.e., orally and in writing, using graphs as well as text).

Category II, Student Attitudes, was sub-divided into (a) personal development and (b) social development. The distinction between students' personal and social development was based on definitions offered by Bell and Cowie (1997). Students' personal development is related to their learning about themselves as learners and about learning to learn. Students' social development is related to their interacting with others in the classroom. When assessing student attitudes, teachers used personal communication, checklists and student self-assessment forms.

The final category included student products and projects. Though not observed to be assessed by every teacher, the two teachers who did assess products and projects used performance assessments. One of the teachers used a written scoring rubric which included self-assessment by the student.
Table 4.7
Achievement Targets and Methods Used to Assess Them

<table>
<thead>
<tr>
<th>Achievement Target</th>
<th>Method Used to Assess the Achievement Target *</th>
</tr>
</thead>
<tbody>
<tr>
<td>I) Student Achievement</td>
<td></td>
</tr>
<tr>
<td>A) Science content</td>
<td></td>
</tr>
<tr>
<td>1. Vocabulary</td>
<td>Oral and written Q &amp; A; oral Q &amp; A during a teacher demonstration of science phenomena</td>
</tr>
<tr>
<td>2. Explanation</td>
<td>Oral Q &amp; A; class discussions; charts; journal writing</td>
</tr>
<tr>
<td>3. Reading comprehension of science text</td>
<td>Oral Q &amp; A</td>
</tr>
<tr>
<td>4. Knowledge structure</td>
<td>Concept mapping</td>
</tr>
<tr>
<td>B) Science processes</td>
<td></td>
</tr>
<tr>
<td>1. Science inquiry skills</td>
<td></td>
</tr>
<tr>
<td>a) Making predictions</td>
<td>The prediction, a written entry in activity log or notebook, is compared to one or more written observations made over a time period of days or weeks</td>
</tr>
<tr>
<td>b) Drawing conclusions</td>
<td>Students write conclusions, either individually or in groups, and then these conclusions are discussed in class and/or submitted to the teacher</td>
</tr>
<tr>
<td>c) Reporting on findings</td>
<td>A combination of oral reports to the class and a written report submitted to the teacher</td>
</tr>
<tr>
<td>2. Laboratory skills</td>
<td></td>
</tr>
<tr>
<td>a) Using equipment</td>
<td>Observation by teacher while students are working in the lab or at tables in groups; checking equipment after student use</td>
</tr>
<tr>
<td>b) Recording data</td>
<td>Written activity log entries (drawings and/or words); tables; graphs of data; observations of students recording their data</td>
</tr>
<tr>
<td>II) Student Attitudes</td>
<td></td>
</tr>
<tr>
<td>A) Personal development</td>
<td>Personal communication; journals; conversation with individuals; whole class discussion</td>
</tr>
<tr>
<td>B) Social development</td>
<td>Personal communication; checklist; student self-assessment report</td>
</tr>
<tr>
<td>III) Student Products/Projects</td>
<td>Performance assessments with or without written scoring rubrics</td>
</tr>
</tbody>
</table>

Note: *a = Assessment method was observed being used in the classroom
Assessing vocabulary. Not unexpectedly, while all of the teachers in the study used oral questions and answers to promote the learning of science vocabulary, not all teachers used the same Q & A techniques. One of the eighth grade teachers, T8B, relied heavily on the textbook and worksheets. The students looked up vocabulary words and then they went over the correct answers in class. The following is an example of a traditional use of oral Q &A to identify 'correct' definitions.

Teacher: Alright, let's start with our vocabulary words. We won't have time to finish, but we will do as much as we can today.

Teacher: Contact metamorphic deposits. Rachel?

Student: Local concentrations of minerals formed at the contact between an igneous intrusion and the surrounding rock.

Teacher: Contact metamorphic deposits are local concentrations of minerals formed at the contact between an igneous intrusion and the surrounding rock. What does intruding mean?

Student: (inaudible)

Teacher: ....it doesn't necessarily belong there, it just intruded. Just like when you burst into the classroom without knocking, you are intruding. Just like this rock, all of the surrounding rock is not igneous. This is just a unique area where this rock has intruded into the surrounding area. Alright, the next work is gangue.

Teacher 7A, the only teacher in the study who did not have certification, did not use the student textbook at all. She used her college biology textbook and made an outline of the science content that she wanted her students to learn. She taught by
writing the outline on the chalkboard and having the students copy it into their notes. Next she would help them understand the material by relating it to something they knew. Then the students practiced answering the questions on the test. The following example illustrates a “test rehearsal” in her class and demonstrates how she focuses on vocabulary.

Teacher: Okay, there is one more section I wanted to get to you but I am not going to give it to you now, so it won’t be on the test tomorrow. So I will leave those out. Test is tomorrow. We are going to go over it so you will know it tomorrow. We are not bringing those [study guides] tomorrow. We are going to do these [questions] right now. Does everyone have one? Okay. See if you can answer what I am asking for. It would be better if you didn’t look at your notes. … Okay, give me your attention please. …Okay. Red marrow produces one of the most important things for your immune system. What is it? Red marrow produces one of the most important things for your body. What?

Student: Blood cells.

Teacher: Thank you, Kyron. It produces white blood cells which are important to what system? To fight off disease what system do you need?

Student: Immune system.

Teacher: The yellow marrow produces and has an energy store because it has what kind of cells in it?
Students: Fat cells.

Teacher: You need to know where the periosteum, compact bone, spongy bone, and marrow. I am going to use that exact drawing that I gave to you in the handout. The outside layer is what? Periosteum. Then goes compact bone. Then goes spongy bone. Then goes marrow. PCSM. PCSM. PCSM. PCSM. People can see me. People carrying some money.

Student: People can smoke marijuana.

Implementing the science standards implies that the students acquire knowledge. However, knowledge of facts, laws and theories should not be an end in itself, but lead to understanding of science (NRC, 1996). The next example shows how one eighth grade teacher combined knowledge of terms with understanding of the concept. T8A used a Q & A technique to promote student learning of science vocabulary. However, she introduced the science vocabulary by first doing a demonstration and then having the students practice using the terms by talking about the demonstration. She tried to establish an understanding of the concept before she introduced the science term.

Teacher: We just talked about how heat flows. If I light this candle underneath the copper pipe, what do you think is going to happen to the little wax pieces?

Student: They will melt. get hot

Teacher: Which one will melt first?

Student: The first one.

Teacher: This one? The one closest to the candles? Why not this one?
Student: Because it has to go way down there
Teacher: Why do you think it will flow in that direction? Okay, the heat is here and this will be the area of what kind of concentration?
Student: Heat, no greater
Teacher: The greater concentration and is going to be moving to
Student: A lesser concentration
Teacher: A lesser concentration. So which wax should fall off first?
Student: Closest ones
Teacher: The one closest to the candles. I am going to leave this here to try to heat it a little bit faster. Everyone should watch the wax.
Student: I can’t see
Teacher: If the heat moves through the copper pipe easily, what do we call it? We say it is a good Conductor.
Student: Conductor
Teacher: Conductor. Very good. So what do you think we are trying to show here?
Student: How good a conductor copper is
Teacher: Are we trying to show how well to conduct energy?
Student: One already fell
Teacher: Okay, one already fell. So which one do you think will fall off next?
Student: The second one
Student: No the third one
Teacher: So what do you think will happen next? Some people say that this one down here will fall off next.

Student: 3rd one.

Teacher: Why not the second one?

Student: It looks like it is stuck on there.

Teacher: The second one should fall off next. We are watching. Look what is happening.

Student: The second one is slipping off

Teacher: The second one. Does that prove that the heat energy is going from here, down this rod and traveling from greater to least concentration?

Student: Yes

Teacher: So which one would be the last to fall off?

Student: The last one.

Teacher: The last one on the pipe. Does anyone know what this is called,

Student: Pipe

Teacher: When heat travels through a medium? It conducts so it is called what?

Student: Conduct

Teacher: Conduction

Teacher: There goes the third one. So what’s next? Does everyone agree that heat is traveling from a greater concentration to a lesser concentration through the pipe?
Student: Yeah.

Teacher: I thought it would move faster than it did. Do you think that the heat energy would travel the same speed through a different medium? For instance, if I put a piece of steel up there,

Student: No

Teacher: Would it move at a different speed?

Student: Yeah.

Teacher: What about if I put a piece of aluminum up there? So we say that this is what? A good conductor. So this is called conduction of heat. The conduction of heat. You can feel it this is a lot warmer than this. I don’t want you to touch it. The wax pieces is what shows you that the heat is traveling.

Student: If you put a match in a pipe, what would happen?

Teacher: If I put one here in the middle, what would happen? Would it move in one direction? The match is the source of heat so it would move to the lesser concentration.

Assessing student explanations. Understanding science requires that a student integrate a complex structure of many types of knowledge, including the ideas of science, and ways to use the ideas to explain and predict other natural phenomena, and ways to apply them to many events (NRC, 1996). A classroom technique, “tell me why,” was used by a teacher and a sixth grade student. The teacher was trying to determine if the students could explain why a person needed kidneys to live.

Teacher: Can you live with one kidney? Can you live without a kidney?
Student: (several talking at once) Yes. No. No.

Teacher: Somebody raise your hand and tell me why? Why can’t you live without a kidney?

Student: Because that [kidney] cleans your body.

Teacher: What does it clean your body of?

Student: Poison.

Teacher: Very good. What do you call this right here?

Student: A bladder

Assessing reading comprehension of science text. The ability to examine books and other sources of information to see what is already known about a topic is a skill needed by students if they are to develop knowledge and understanding of scientific ideas and participate fully in scientific inquiry. According to NSES, inquiry is a multifaceted activity that involves examining books and other sources of information to learn what is already known about a topic (NRC, 1996). T6A and her students were reading a section in the science text book about the Precambrian time period. Geologic time is a difficult concept for many students (Pulling, 2001). Helping students become better readers was a long term goal for her students that was clearly important to T6A. In the following exchange this first year teacher was trying to promote science learning and informally measure her sixth grade students abilities to read and understand their science textbook.

Student: "The Precambrian represents about seven-eights of Earth’s history. It began when Earth first appeared. It lasted until lots of fossils of organisms with hard parts appeared in the fossil
record. But we know less about life in this period than any other era” (student textbook, p.62).

Teacher: Good. When did the Precambrian period begin? Monica?

Student: Seven-eights of Earth’s history? (reading from text)

Teacher: That’s how much it represents. When did it begin? Lance?

Student: When earth first appeared.

Teacher: When earth first appeared is when the Precambrian period began. Remember when we began this lesson Monday, our time period for this era was the Precambrian time period but what was the number? 4.6 billion years ago to? To? How far did it cover?

Student: 570 million years ago.

Teacher: 570 million years ago. This is when earth first appeared. Good job! Anthony, continue reading.

Student: “Why do we know so little about Precambrian life? Part of the reason is that Precambrian fossils are hard to find. Most Precambrian organisms had soft bodies. Probably, few of the organisms that did have any hard parts were preserved in the fossil record. And over time, Earth’s processes have destroyed much of that evidence” (student textbook, p. 62).

Teacher: There are two reasons why we know so little about Precambrian life. Two different reasons, who can give me one?

Student: Part of the reason is that Precambrian fossils are hard to find.
Teacher: Good job. Precambrian fossils are hard to find. And Jennifer?

Student: Most Precambrian organisms had soft bodies.

Teacher: O.K. They had soft bodies that’s not a reason why, it is explaining why they are hard to find. They are telling us they are hard to find because most had soft bodies. Think about that. It will make sense if you really think about it. If something is very soft, what can easily happen to it?

Student: Get smooshed.

Teacher: It can smooshed.

Students: (inaudible)

Teacher: I heard break up. Think about it if you had a cracker in your school bag?

Student: Smooshed (rest is inaudible)

Teacher: Smoosh, crush, break apart. So it’s not going to survive. So that is why they are saying that they are hard to find. So many of the organisms had soft bodies. Okay, we still need our second reason. Ariel?

Student: Probably, few of the organisms that did have any hard parts were preserved in the fossil record. (reading from text)

Teacher: That’s still explaining why they are hard to find. Anthony?

Student: And over time, Earth’s processes have destroyed much of that evidence? (reading from text)
Teacher: Very good, over time, Earth’s processes had destroyed much of the evidence. You have to be careful when we are looking at our questions. Make sure you are not putting a reason, an explanation of a reason as a second reason. Your second reason, if you have more than one reason it will not always follow nice and simply. They may stop and explain why this is so. And that is what they did. They explained why the fossils were hard to find. Ariel, read about molds for us.

Assessing knowledge structure. The following exchange between T6B and a group of students occurred during a presentation in which the group was explaining their concept map to the teacher and the whole class. During the presentation, it became clear to the teacher that the students’ concept map implied that the sun was in one of the layers of the atmosphere. The teacher encouraged the students to think their way to a more correct understanding of where the sun is located in relation to the earth and the other planets. As noted in the science standards, one of the teacher’s many roles is to challenge students’ current beliefs and concepts and provide scientific explanations as alternatives (NRC, 1996).

Teacher: Listen up. I want you to understand and I want to understand what you are talking about with the sun and stratosphere.

Student: Stratosphere was a layer in our atmosphere. Our atmosphere is (inaudible) because it gives us sunlight.

Teacher: Is the sun is in one of those layers?

Student: Yes
Teacher: Does everyone agree with that?

Students: Yeah, we do.

Teacher: So if the sun were one of those layers, I want you to think about it. How hot would it be on earth if the sun was in one of the layers?

Student: 90 degrees

Teacher: Let's look back and get some information.

Student: 80 kilometers.

Teacher: If the sun were 80 kilometers from earth, what would happen?

Student: We would burn...

Student: We would burn into dust.

Teacher: We know for a fact that there are planets closer to the sun than we are. Is that correct?

Students: Yes.

Teacher: So you are saying the sun is 80 kilometers from the earth. You must be making a statement that there are planets within that 80 kilometers in another layer. I want you to think really hard. 80 km is really not that far.

Student: She just guessed that cause it was an answer on (inaudible).

Teacher: The sun is way out, out in outer space.

(intercom announcement)

Student: Look, the reason we put the sun there is because it show in the book they had the layers (rest is inaudible)
Right, but you only put two of those layers. Remember, I told you to pay attention to the two clumps of information but to look at that diagram. If you would have looked at the diagram closely, you would see a difference there. OK. Let’s clear up the problem with the sun. I want that cleared up before we sit down. Listen to me. The sun is not in the layers. These layers are layers of the earth’s atmosphere. Okay? … Now the sun. What does the sun have to do with all of this?

Because it gives off sunlight and nutrients and stuff from its --- gravitation.

The stratosphere is the layer of the atmosphere that contains an ozone layer. The temperatures rises as we go higher because the ozone absorbs some of the sun’s energy. Stratosphere absorbs some of the sun’s energy. Solar radiation is the energy released by the sun.

Exactly. So the sun has to do with the energy-- the heat energy. The heat energy is what the sun is doing. The sun is giving you the energy, the heat up those layers. Is there anything else you want to add?

No ma’am.

Take a seat please. Let’s see what time it is. They pointed out a very important part that they will add to their concept map. I
want to make sure everyone has it. I know this group has some other information to add to that that I want to talk about real quick. The layers they said was heated by the sun. Sun gives off solar radiation which heats the layers of the atmosphere and the earth itself. What else about solar radiation? Remember the connection Kyran made in your group yesterday about solar radiation. What did he say?

**Assessing students’ inquiry skills.** Teachers must decide when to challenge students to make sense of their experiences. Students should be asked to explain, clarify, and assess their work (NRC, 1996). Teachers must also decide when and for what purposes to use whole-class instruction, small-group collaboration, and individual work (NRC, 1996). In this first example, T6A organized her sixth grade students into groups of three and four to answer the question “What happens when hot and cold air mix?”. The teacher located two science activities on the internet that she believed would provide the background experiences students needed to understand what happened when air masses mix. The teacher explained that, for this activity, they were substituting water for air because it was easier to see the water. She had prepared red and green ice cubes at home in advance of the lesson. The following exchange takes place after the students have mixed hot water (clear) and cold water (red ice cube). This example illustrates how the teacher helped a student clarify “What’s happening here?”

Teacher: Remember that we are experimenting to show how air reacts when hot air comes in contact with cold air. That was the
whole experience. Instead of air we are using water. So we are using hot water and cold water. What happens when you introduce the cold water to the hot water?

Student: It mixed in but it dissolves, the ice cube dissolves.
Teachere: What is representing the cold water?
Students: The ice.
Teacher: The red dyed water. That's what the cold water is. So looking at this jar, what can you tell me about the cold water and the hot water.
Student: It's all mixed.
Teacher: But what is happening? What is physically happening in that jar?
Student: They have more hot water in the bottom so the cold water couldn't take up all the hot water until it dissolves.
Teacher: So what you are saying that because of the amount of hot water, that's why there is only just a little bit of cold water on the bottom. Well why isn't the cold water up on the top?
Teacher: Why is the cold water on the bottom? Don't shake your jar because you are going to mix up your colors.
Student: Because that is where the ice is and it's going around.
Teacher: Okay. You're on the right track. You keep mentioning the ice.
If I'm not mistaken, I see no ice now.
Student: It melted.
Teacher: The ice cube was red and it melted. But we see the red in there. Why is that red on the bottom and not floating at the top?

Student: Because the ice cube is stuck. When the washer was down there it mixed in the bottom more because it was surrounding the top like it was the first time.

Teacher: But the washer is not holding that water down now. That’s what I am trying to get from you. Why is the cold water on the bottom? What can that tell you about hot and cold air? The water is representing air. Cold air and hot air and it still doesn’t mix. So what does it do?

Student: It moves all around. The cold water goes to the bottom.

Teacher: So if you are intermixing the terms here. Cold air goes to the bottom. Hot air goes to the top. So what are you saying?

Student: They don’t mix.

Teacher: You said it. Cold air goes to the bottom. Hot air goes to the top. So cold air is what? It’s going down below. What do you call that?

Student: Gravity?

Teacher: Sinking. So the hot air is?

Student: Rising up.

Teacher: Rising. Thank you. So do you see that? What’s happening here? The cold water has sunk to the bottom and the hot water
is staying on top. So now, what happens when hot air meets cold air?

Student: They don’t mix. The cold water goes to the bottom.

Teacher: Thank you.

This second example illustrates that, as noted in the science standards, teachers change their actions (teaching plans) as a result of assessing students ability to do inquiry (NRC, 1996). The seventh and eighth grade students at this school have science class, on alternate days, for 90 minutes. Both the teachers and the students seem satisfied with what they call the A-B schedule. Science standards recommend that adequate time and space be allowed for science (NRC, 1996). This teacher has the use of two connecting rooms, one is a science lab and the other is a classroom equipped with tables and chairs. At one time the rooms only opened into the hall, but the teacher had a doorway cut into the wall separating the two rooms and is able to move back and forth with all of the students or any portion of them.

Teacher: Okay. Put your notes and put your books away. Put your books back in the stacks on the bookshelf. We are going to do the activity that we started [yesterday]. We are going to have to start it again because we didn’t get finished with it the last class period. So we are going to go over some things that I saw which really made a difference in your activity. Just some precautionary things to look for with our thermometers and our temperature and then we are going to go back in and do this activity. Everyone needs to look at me. We are going to do it
in the lab just like we did before. But there are some procedural things that I saw which concerns me about your outcome.

Student: The baseline temperatures.

Teacher: Baseline temperatures. Good. And then the other thing I looked at after you left, some of the thermometers were sliding down off the grid. So if you had to take the thermometer and had to pull it back up, you added to or took away from the thermometer. What I have done was go back and mended all of the thermometers. But before you start your activity you need to check and make sure your thermometer top is right on the F. There is a little line with the F. Make sure that the glass part of your thermometer's top is right at that line and it is taped. So it should stay there. If it is not at that line, we will have to adjust it.

Teacher: ...We are going to make another chart because we don't want to contaminate the data or confuse the data that we have now. So the charts that you had from last period, just discard them. We will not need them. That means, however, that we need to make a new chart. This is the way we are going to set our charts up. We have our time and in our first part of the time we will start with baseline because we are not going to time our baseline. Who can remember what our baseline temperatures are?

Student: Intervals.
Teacher: Good. Those are intervals. What is it though?

Student: Temperature, before you do anything with the thermometer.

Teacher: If you touch the plastic and you take it up, you have your water bag in your hand with the cold water in it, right before you put your temperature in your bag, write down your temperature for the cold thermometer and then you put it in your water. Right before you put it in the water, you take your baseline temperature. Then you add the temperature of your cold thermometer for your cold water. Then you will do the same thing with the warm water. When I bring you the warm water, you will measure it and put it in the bag. Right before you put your thermometer in the warm bag, you check the temperature of that thermometer. They may or may not be the same because every thermometer does not measure exactly the same. These thermometers are not expensive thermometers. But there are some discrepancies. But as you go through your activity, it will all work out in the end. We just have to be careful that we need two baselines so we know where we started. Now, once you get your baselines you will go every 30 seconds.

Another important aspect of students' ability to engage in scientific inquiry focuses on being able to use their math skills to record and analyze data. This third example shows T8A working with individual students within small groups to assess student understanding of how to graph the data collected during an experiment. The
students are setting up a graph with temperature on the y-axis and time on the x-axis. Many of the students found graphing their data very difficult. It took careful and consistent monitoring by the teacher to help students complete the graphs.

Teacher: No. We are just going to do this. Now across the bottom of your paper you are going to do time: .5, 1, 1.5, 2, all the way to 15. What do you notice about the numbers?

Student: They are spaced out.

Teacher: How are they spaced out? There are 5 spaces between each one, at regular intervals. Every 5 spaces I have a number. Can I put this one here, one here, and the 1.5 way over here?

Student: No.

Teacher: No, because it will make my graph look funny. And it won’t let us read the information we need from the graph. So it is very, very important that when you are graphing your information, bar graph or line graph, that these are at equal intervals and the temperatures that go up the side.

In addition to learning laboratory procedures and how to graph data they collected themselves, the same experiment provided students with the opportunity to use their data to draw conclusions. Each group made a brief presentation, thus, allowing the teacher to assess the student’s ability to make conclusions and communicate them to the class. She frequently called on other students within the same group to help clarify issues that became confused during the presentations. As
noted in the science standards, one way that teachers facilitate learning is to orchestrate discourse among students about scientific ideas (NRC, 1996).

Teacher: Read the last part of your conclusion, Dora.

Student: The cold water was absorbing the hot water.

Teacher: Okay, the cold water was absorbing the hot water. So Kevin, straighten that out for me.

Student: The cold water was absorbing the hot water’s energy.

Teacher: So the cold water was absorbing the hot water’s energy. What is the hot water’s energy?

Student: The heat.

An important stage of scientific inquiry and student learning is the oral and written discourse that focuses the attention of students on how they know what they know (NRC, 1996). Effective science teachers support and guide this discourse when they require students to record their work using many different formats (i.e. pictorial, graphic, mathematical, written). The last example of how teachers assess students’ ability to engage in inquiry illustrates how a first year, fifth grade teacher helped students assess their own predictions and learn to record their observations. Sometimes this class worked in small groups and sometimes the teacher and one or two students participated in setting up one experiment for the whole class. In this way the teacher was able to engage the students in several on-going experiments at one time.

Teacher: Let’s see. Lakedro, would you come up and dunk it in water?

Basically, she is just dunking it in water and getting it good and
wet. Now hold it up over the bowl. You can see when she holds it up there is still water in there. When we take it out, we are not taking all the water out. Get a good dunk again. We are going to let it sit in this bowl for three days. What you need to do is make a prediction of what you think is going to happen to the steel wool. We are going to do an activity log in just a minute. Write your prediction. What do think is going to happen to the steel wool after three days? We will look at it on Monday. Remember it is the steel wool, not the water. What do you think? Remember prediction is your thoughts. They are not always going to be accurate. We are going to come back on Monday and check your predictions and even if it is wrong, it is not wrong because it is your thought. Do not forget your name, homeroom, and date. It’s only the first question you can answer at this time. After wetting the steel wool and putting it in a bowl, write a prediction about what will happen to it. …Let’s continue.

(During class the following Monday, the students were given time to check their predictions against their observations.)

Teacher: For those that are finished, you can turn to page 31 and refresh your memory with our steel wool activity. Does anyone need a little more time? Remember don’t ever change your prediction, even if it is not correct. It is a prediction, what do you think.
Technically there is no right or wrong when you answer the question. Okay, page 31 iron and oxygen. Remember this is what the steel wool looked like. What did we do to it?

Students: Dunked it in water.

Teacher: We got it nice and soaked in water and then we let it sit for three days. What I will let you do is come up. You will come up and look at it. Then you will record your observations of the changes that have occurred. The second question, after three days record your observations. You are going to write down what changes did occur to the steel wool. Remember we are talking about the steel wool, not the water. Then your last question on this page, was your prediction correct? Yes or no. Then add something to that. Yes, my prediction was correct because... No, my prediction was not correct because I thought but actually ... That is how we will take care of that question.

Okay, we will start with Row 1 and Row 2. Come and take a quick look. Remember this is the fresh one [dry piece of steel wool]. We did nothing to this one. If you want to touch it, carefully touch it. Touch it very carefully. Row 3. Row 4. Row 5. Row 6. Remember to record the changes you notice, how did it change, and was your prediction correct. Go ahead and record your observations of change. Page 31 of your log what does it look like, what changes have occurred to it, and
was your predictions correct. More than just yes or no. A little more than that.

**Assessing student attitudes.** A distinction was made between students’ personal and social development based on definitions offered by Bell and Cowie (1997). Students’ personal development is related to their learning about themselves as learners and about learning to learn. Students’ social development is related to their interacting with others in the classroom (e.g. group work). Four examples of teachers assessing students’ attitudes are offered below. The first two examples highlight assessment occasions when teachers were assessing students’ personal development.

This first example illustrates T8A assessing a student’s personal development. The first exchange illustrates a conversation between an eighth grade girl and her teacher. One of the teacher’s long term goals for her students is for them to take responsibility for their both their learning and their classroom behavior. Many of her students seemed to have a problem with self-control which was evidenced by outbursts of disruptive behavior and/or very loud voices. However, these outbursts were handled quickly, with caring and without escalating the inappropriate behavior. As the teacher was checking to make sure that all students returned folders that had been sent home to parents to be signed, one student repeatedly called the teacher’s name. The other students were reading science trade books and the student’s behavior was causing a distraction. The student, Chandelle, stood up, walked over to the teacher’s desk and continued to call her name. Their exchange, picked up by the tape recorder on the teacher’s desk, is reported below.

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Teacher: Chandelle, please sit down. Please do not make me fuss at you. I have talked to you about this how many times?

Student: (inaudible)

Teacher: Right. And what did we discuss? What were you supposed to do?

Who is responsible for coming to me and saying, I am ready to take this make-up test?

Student: Me.

Teacher: So why are you complaining to me when you haven’t come to tell me you want to take it?

Student: (inaudible)

Teacher: You do need to make up these tests. You need to do it quickly. If you were absent, where are your papers?

The second example of a teacher assessing a student’s personal development (learning how to learn) involved a planned integration of assessment and instruction. Each week this sixth grade science teacher wrote five questions on a sheet of poster paper and attached it to the chalk board. When the students arrived for class, they copied the question of the day into journals or notebooks and wrote down as many ideas as they could related to answering the question. A class discussion followed and the students pooled their ideas to discuss possible answers to the question. One day, the discussion centered around the following question: “Psychologists have found that students who actively work with information they hear or read, retain it better than those who memorize through repetition. How can you use this information to study
more effectively”? The following interaction was taken from the sixth grade class discussion.

Teacher: First off, I had a talk with Alan about what the word ‘retain’ means.

Student: I heard you.

Student: Like when you supposed to be in the 6th grade and going on to the 7th grade and you pass but they held you back.

Teacher: That’s if you are retained [in] a grade. How [did] I relate that to helping you [study]?

Student: (silence)

Teacher: You didn’t hear that part. Alan, could you share that with us?

Student: Like, say, a student does not have good grades, but in science class, he reads his notes over and retains what he read, so you can read and memorize what you read.

Teacher: Retaining is a synonym of remembering in this particular sentence. If you are retaining the information by hearing it and reading it, you are remembering the information better than if you just memorized it by repeating the information over and over.

Repetition means doing it over and over again. A lot of you learned your ABC’s somewhat like that. Then how can you use that information to study more effectively?

Student: (inaudible)

Teacher: If you are reading it and reading again, what is that?
Students: You’ll memorize it

Teacher: No. What do they tell you? If you can read it and hear it you are going to retain it better than if you do it in repetition. So if you are reading it over and over again, that’s repetition. That’s not what they mean. They mean that if you are reading material and you are also hearing it being read, you are going to remember it better than just doing it over and over. How can that information help you study more effectively? What’s the other things maybe you could do along with that to help you study more effectively?

Teacher: How can you remember that information without reading it over and over again? or hearing and reading. That’s what I am trying to get at. If there are some kind of study habit that you have that you could use to go along with reading and hearing the material for instance, you are doing some of it this week.

Student: By writing it down.

Teacher: By writing it down. That’s a good way to do it. Is that what you are doing here?

Student: Yeah. I wrote all this down. Sometimes when you are doing it you have to just let it come to your mind. You have to brainstorm a lot but just don’t focus on too much. Let it come to your mind easy.

Teacher: Try not to think so hard. But I like the word you used brainstorm. That’s a very good way of thinking about information.
Student: Record it.

Teacher: Record it. Very good. Do you mean by what method? How are you going to record it?

Student: You can write it down or record it.

Teacher: Oh. You think we should be on tape.

Student: Say you are in a group and you got a test coming up and you got to read the question, the one person reads the question and you answer it. That's a good way.

Teacher: Some other ways that you can remember information would be to outline it. You know when you are making a report, I know you've done it in English, outlining where you outline the most important information in the report and then you put it together to create a report. You can summarize what you've read in your own words. A lot of times it is easier for you to understand things if you do it in your own words or in a friend's words. I notice sometimes that I have to have students go to help another student to understand what I teach. That's called peer tutoring. The process of pointing out the most important points and deciding what is the most important material you have been studying and you can take notes as you study. Then you can leave room in the margins of your notes and write down some comments or questions you might have. Maybe you can ask your teacher later about it and it might help you to understand it. Good discussion!
Students need to have certain social skills to work collaboratively with others; and, the national science standards point to the need for teachers to teach students the skills that are needed to work together (NRC, 1996). Four of the eight teachers were observed assessing students' ability to effectively participate in group activities. The examples were selected to illustrate methods used by two of the teachers in this study to assess the social development of their students.

During several group activities, but not all, the researcher observed a first year, fifth grade teacher walking from group to group with a clipboard in her hand and occasionally making notes. The assessment target was identified by the teacher during an interview.

KM: ... I have seen you with a clipboard at different times for different things.

Teacher: I have a small form that I use and they are scaled sometimes from 5-0 points, sometimes 4-1. It's like four different chances that they [students] have and how well they work with their group, if they are staying on top, if they are following directions, just different things like that and score it as I go along. Okay, if someone is talking, they go from a 5 to a 4. I'll underline the 4. I don't go through and mark on all of them at the same time.

Teacher: It [the check list] is really wonderful and the majority of the time when we do group work I do use it, but not always, depending on how much I know I am going to be involved in that activity, like yesterday.
KM: But you use a lot of these sheets. Did you make these up over time?

Teacher: I did this myself and I just revise them as necessary. Like this one went from 3 to 1. So if I notice Katie is arguing with her group members and trying to take over, I'll underline the 2 and then, okay, if she is fine all throughout, she will end up with a 2 for this one. For this one, it's possible to get 15 participation points and if that is the only time I have to mark hers, she has 14 points out of her 15. If I never have to correct the group, never see them clowning or anything, that person gets her 15 points. I started that when we started activities because I feel they need to be rewarded for working with that group because that is an effort to learn how to work with other people in a group. Our groups are constantly changing.

This second example is an unplanned personal communication, a conversation between the teacher and a group of students. It was selected because a sixth grade teacher was helping her students to assess themselves and their group. She did this by having one the members of the group identified as "assessor". One day two students in one of the groups were arguing. As the teacher approached the group to see what was causing the problem, one of the students in the group asked the teacher to explain the difference between the recorder and the assessor. She responded,

The recorder is writing down the data for the experiment. The recorder has the clipboard. The assessor is writing the evaluation, doing the evaluation for the
group. Make sure you write participants, their names, their jobs and then I need a report on how the group is interacting. If there is someone in the group that you feel may not be putting in their best work today, we need to know why. Any problems. If you have some major problems, you might want to tell what they are. If your group had any major strengths, how well did your group work today? Did they really have something going good for them? Were they able to operate really great? You have to write those. Something that you might want to change for now. There is something that you know that you could do in your group that could change it to make the group work better, then you need to put it down.

Assessing student products and projects. Allowing students to work on projects in class requires that the teacher combine monitoring for behavior with monitoring for learning. One of the seventh grade teachers, T7B, had her students work on their dinosaur projects during several class periods. The project had three parts: (a) constructing the skeleton, (b) drawing a picture of the dinosaur in its habitat, and (c) presenting the poster and a short explanatory speech to the class. The students were constructing a dinosaur skeleton from bones which had been provided by the teacher. When sitting together at the tables working on their dinosaur posters, the students were encouraged by the teacher to talk to each other. However, they were expected to be talking about science in the news or any science topic that they found interesting. Two seventh grade boys were beginning to move between tables, so the teacher redirected them back to the task at hand.

90
Student: Luke, come see. This is exactly what mine looks like only it has a bigger head and it has horns.

Student: What does yours do?

Student: Swim.

Teacher: Luke, I appreciate your enthusiasm. Please finish digging up your bones.

T7A monitored the whole class for behavior issues. She monitored individual students working on their projects so that she knew when they needed help with science content or to move to the next stage in the project. In the following example the teacher reminds the whole class where they should be in the project and then walks from table to table checking with individual students. As noted in the standards, classroom assessment has many forms (NRC, 1996). This seventh grade teacher observed and listened to her students as they worked individually and in groups as a form of classroom assessment.

Teacher: What you should have on your desk right now is most of you are either working on making sure that your dinosaur bones are articulated, which means put together, or you finished that part and you are now turned over to the other side [of the poster]. You should be using books or any of the posters around the room. Which you are going to do, the board’s direction say to design, draw and color your dinosaur with its hide on. By that I mean its skin. Then you need to draw an appropriate environment to include plants and food. Label the dinosaur’s
name, the era, the period, and describe the environment from which it came. So your poster will have a front and a back.

The back side will be the one that you dug up.

As soon as the class settled down to the task at hand, the teacher began to move from table to table talking with individual students. Her easy manner, quick sense of humor, and her message ‘you can work and play at the same time, as long as you are working’ seemed to appeal to this group of seventh graders. No serious disciple problems are in evidence and multiple science conversations on a variety of topics can be heard.

Teacher: Okay, Kevin start your environment. You don’t have to put it right on there. Look in the book if you want to. You can get up and look at the other examples.

Student 1: That’s all I have to do to this side?

Teacher: Yes. You have to draw your animal in its environment. I like that one up there.

Student 1: I like that one, too. I like the one with the brontosaurus and the little thing-a-majiggy.

Student 2: (Jerrod is sitting next to Student 1)

Teacher: Jerrod, I love your dinosaur. Excellent. You need to get one of these books and see if you see something in there that you like, unless you already have a plan. And if you already have a plan you just go right ahead.

Student 3: (seated at another table says something that I do not hear)
Teacher: No I don't want you to buy another poster. I want you to finish on this. You have something here. You stick with that. Keep going. Keep going.

Student 4: (seated at the same table)

Teacher: You're almost done, right? Gather your stuff up. I think you need some thicker outline in some places.

Student 5: (Gabrielle is seated at another table)

Teacher: How's it going over here girls? What kind of foliage did you choose to do Gabrielle? Leaves. What kind of leaves? Are they fern-like leaves or is it more of a modern forest?

Student 5: (inaudible)

Teacher: That's right. That forest which you got that idea from actually looks like a rain forest. So if it is earlier in the Mesozoic, what kind of plants would they have been?

Student 5: Ferns and herbs.

Occasionally, when the students were working on their projects, T7A moved conversations back and forth between small groups and the whole class. This seemed to be an effective, informal method used to assess student knowledge and understanding. Additionally, it provided a kind of spontaneous review of science content. As students worked on their projects, the teacher constantly kept their minds on the science content they were learning. In this classroom, hands-on demanded minds-on.

Teacher: What kind of tree do you think this is?
A palm tree.

What was the name that I told you the palm tree was called?

Conifer?

No. That's a cone. It makes a cone. Does anybody remember the name what did they call the palm-like plant?

Conifers.

Conifers are the cone plants. Does anybody remember what we call those?

Pine tree.

No. Pine trees are conifers. Cypress trees are conifers. What did they tell you the name of the palm-like plants are?

Cycads

Part of the vision for science teaching and assessment in the science standards is that students be given more responsibility for assessing their own work (NRC, 1996). One way to do this is to allow the students to score their projects using a scoring guide. The written scoring guide used to evaluate the students dinosaur projects is in Appendix I. Part of the project was evaluated by the teacher and part of the scoring system allowed for students to assess themselves. In addition to the scoring guide, the teacher gave the following verbal directions to the students.

You have one minute. You can explain what you wrote. You need to show your bones, what era, what period, and talk about the plants. Okay. By the way, there will be no hesitating. When you hear your name called, don’t be mud. That means
jump out of your seat, push your chair in and get up there or I’ll start whacking points off because we are on a time limit.

(Following the presentations, the teacher gave the following instructions to the students.)

Teacher: Okay. Guys, I will hand these [scoring guides] back out to you.

Somewhere on the front I want you to write to me what you like about your dinosaur, what you liked about your art project, what you would change if you had a chance. Tell me how you felt about this project.

Matching Achievement Targets and Assessment Methods

Neither the science standards nor the benchmarks suggested criteria to use in identifying appropriate matches between achievement targets and assessment methods. Andrew Ahlgren, associate director of Project 2061, noted that there is “no useful synthesis of the latest thinking on assessment, much less practical advice on how to judge alignment of assessment with learning goals” (cited in Nielsen, 2001). However, it was suggested by the authors of NSES that the format for classroom assessment is best determined by the learning goals and the experiences of the students (NRC, 1996). Therefore, in order to identify appropriate matches between classroom achievement targets and classroom assessment methods, the researcher used written lesson objectives provided by the teachers as learning goals (achievement targets). The classroom lessons, observed by the researcher, provided a common base of experiences for the students. Additionally, a modified version of an original framework by Stiggins (1997) was used during the analysis. Table 4.8 shows the
matches teachers made achievement targets and assessment methods during the time they were observed by the researcher. Stiggins choices are identified with Xs, Os, and Ps. The symbol (T) indicates choices made by the participants in this study.

Table 4.8

**Appropriateness of Matches Between Achievement Targets and Assessment Methods**

<table>
<thead>
<tr>
<th>Achievement Target</th>
<th>Selected Response</th>
<th>Essay Assessment</th>
<th>Performance Assessment</th>
<th>Personal Communication</th>
</tr>
</thead>
<tbody>
<tr>
<td>Knowledge</td>
<td>X</td>
<td>X</td>
<td>O</td>
<td>P (T)</td>
</tr>
<tr>
<td>Reasoning</td>
<td>P</td>
<td>X (T)</td>
<td>X (T)</td>
<td>X (T)</td>
</tr>
<tr>
<td>Skills</td>
<td>O</td>
<td>O</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>-- making predictions</td>
<td>(T)</td>
<td>(T)</td>
<td>(T)</td>
<td>(T)</td>
</tr>
<tr>
<td>-- drawing conclusions</td>
<td>(T)</td>
<td>(T)</td>
<td>(T)</td>
<td>(T)</td>
</tr>
<tr>
<td>-- reporting findings</td>
<td>(T)</td>
<td>(T)</td>
<td>(T)</td>
<td>(T)</td>
</tr>
<tr>
<td>-- using equipment</td>
<td>(T)</td>
<td>(T)</td>
<td>(T)</td>
<td>(T)</td>
</tr>
<tr>
<td>-- recording data (graphing)</td>
<td>(T)</td>
<td>(T)</td>
<td>(T)</td>
<td>(T)</td>
</tr>
<tr>
<td>Products</td>
<td>O</td>
<td>P</td>
<td>X (T)</td>
<td>X (T)</td>
</tr>
<tr>
<td>-- dinosaur poster</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Attitudes &amp; Interests</td>
<td>X</td>
<td>P</td>
<td>P</td>
<td>X</td>
</tr>
<tr>
<td>-- personal development</td>
<td>(T)</td>
<td>(T)</td>
<td>(T)</td>
<td>(T)</td>
</tr>
<tr>
<td>-- social development</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Note.** X = good match; P = partial match; O = not a good match; (T) = used by participants

**Assessment Record Keeping Strategies Used by Teachers in This Study**

Record keeping is an important part of any assessment system. Classroom observations and teacher interviews revealed that teachers used a variety of record keeping strategies including grade books, activity logs, folder systems, scoring guides...
and forms for social skill development (see Table 4.9). Grade books kept by the
teachers were either traditional grade books and/or electronic grade books.

Table 4.9

**Assessment Record Keeping Strategies**

<table>
<thead>
<tr>
<th>Type of Record</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grade Book</td>
<td>Traditional or computerized</td>
</tr>
<tr>
<td>Activity logs</td>
<td>Written by students and evaluated by teachers</td>
</tr>
<tr>
<td>Folder system</td>
<td>Managed by the teacher to help students keep up with their papers and then signed by parents to acknowledge receipt of the information</td>
</tr>
<tr>
<td>Scoring guides</td>
<td>While some teachers used written guides and shared them with students, it was more common to keep this information “in my head”.</td>
</tr>
<tr>
<td>Forms for social skills development</td>
<td>Checklist for teacher to record information about individual students or evaluation sheet for individual group members to report on the social skills of the group as they engaged in a science activity.</td>
</tr>
</tbody>
</table>

Activity logs were used by two of the teachers. These logs, are typically one page long and provided by the textbook publisher. They provide a written record of the science activities engaged in by students. The logs contained the name of the activity or investigation and asked questions of the student, focusing the student’s attention on important concepts to understand and providing a place for the student to record predictions, hypotheses, data generated from the activity, results and conclusions. Six of the eight teachers observed maintained a student folder system;
while the specifics were different, the purpose was the same – to keep students from losing the written work they needed to study for a test or have signed as part of a school-wide accountability system. Not surprisingly, the teachers who did not keep a student folder system taught in schools that did not require that student work be sent home and signed by parents.

While several teachers referred to scoring guides during interviews, only one teacher was observed to use a written scoring guide with her students. One of the seventh grade teachers used a scoring guide to evaluate individual project presentations. Each student also used the same scoring guide to self-assess their own presentation. The teachers who said they used scoring guides also indicated that they were “in my head” and not written down.

Only two teachers were observed using written forms for tracking the development of students’ social skills. One of the teachers used a checklist attached to a clip board. She made written notes on how well the students worked with each other in groups during science activities. The second teacher used social skills development as a way to organize her students thinking about their own group work. One of the jobs built into her cooperative groups was “assessor”.

The Influence of National or State Science Standards on Teachers’ Classroom Assessment Practices

Three sources provided information on the extent to which the national or state science standards influenced middle school teachers’ CAPs: (a) questionnaire responses, (b) teacher interviews, and (c) document analyses of teacher-made tests. The questionnaire items of consequence were those which asked teachers to indicate
factors having the most influence on decisions to select an assessment method, to record the availability and use of science reform documents and those which solicited teacher-generated examples of how they used standards for constructing and selecting assessments.

**Reported by Teachers in the Questionnaire**

**Factors That Influence Teachers' Decisions to Select an Assessment Method**

The data summarized in Table 4.10 were collected using question 1 on the CAPQ, which asked, “Rate the importance of the following factors as to how strongly each one influences your decision to select or construct a particular type of assessment. (Darken a number from 1 to 5 for each factor, where 1 = no influence and 5 = most important influence.)” Table 4.10 indicates that the three most influential factors considered when making decisions to select an assessment method were (a) my understanding of how students learn, (b) alignment with state/district standards, and (c) purpose for assessment. The least influential factors were (a) time it takes for the students to complete the assessment, (b) time it takes for the teacher to grade the test, and (c) provide students with the opportunity to evaluate the knowledge claims of others. Teachers’ understanding of how students learned is further explored in this report in the section “Teachers’ Views on How Learning Occurs” (see Table 4.19).

Kendall’s W, a nonparametric test that can be used to measure agreement among raters was used to evaluate whether the differences in rankings of these factors was significant. Kendall’s W ranges between 0 (no agreement) to 1 (perfect agreement between raters). For the factors listed in Table 4.10, W = .194, which is statistically significant (p<.001).
### Table 4.10

**Mean Ranks of Factors That Influence Teachers' Decisions to Use a Particular Type of Assessment**

<table>
<thead>
<tr>
<th>Factor</th>
<th>Mean Rank</th>
</tr>
</thead>
<tbody>
<tr>
<td>My understanding of how students learn</td>
<td>10.00</td>
</tr>
<tr>
<td>Alignment of test content and format with state/district standards</td>
<td>9.97</td>
</tr>
<tr>
<td>Purpose for assessment</td>
<td>9.87</td>
</tr>
<tr>
<td>Student characteristic being assessed</td>
<td>9.86</td>
</tr>
<tr>
<td>Confidence that the test really measures what I think it measures</td>
<td>9.67</td>
</tr>
<tr>
<td>Alignment of test content and format with state testing</td>
<td>9.55</td>
</tr>
<tr>
<td>Science topic assessed</td>
<td>9.34</td>
</tr>
<tr>
<td>Opportunity for students to build connections between prior knowledge and new concepts</td>
<td>9.32</td>
</tr>
<tr>
<td>Students being assessed</td>
<td>9.12</td>
</tr>
<tr>
<td>Use of assessment information by the teacher</td>
<td>8.93</td>
</tr>
<tr>
<td>Alignment of test content and format with national science standards</td>
<td>8.83</td>
</tr>
<tr>
<td>The need for students to construct progressively more powerful explanations</td>
<td>8.71</td>
</tr>
<tr>
<td>Confidence that the same student taking the test at another time will perform at about the same level</td>
<td>7.34</td>
</tr>
<tr>
<td>Time it takes for students to complete the assessment</td>
<td>5.99</td>
</tr>
<tr>
<td>Time it takes to grade the test</td>
<td>5.06</td>
</tr>
<tr>
<td>Provide students with the opportunity to evaluate knowledge claims</td>
<td>4.44</td>
</tr>
</tbody>
</table>

**Note.** The larger the mean rank the greater the influence reported by the teachers.
Availability and Use of Science Reform Documents

Teachers who have copies of the science reform documents claim to use them as recorded in Table 4.11. Responses indicated that about three fourths of the respondents possessed and used at least one of the science reform documents. However, nearly one fourth of the teachers surveyed reported not possessing and not using any of the reform documents.

Table 4.11

<table>
<thead>
<tr>
<th>Number of Documents</th>
<th>Availability</th>
<th>Use</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>% N</td>
<td>% N</td>
</tr>
<tr>
<td>0 Documents</td>
<td>23 45</td>
<td>24 47</td>
</tr>
<tr>
<td>1+ Documents</td>
<td>77 152</td>
<td>76 150</td>
</tr>
</tbody>
</table>

Table 4.12 shows teachers' use of specific reform documents. Responses indicated that 85 teachers reported using the *Benchmarks* and 60 teachers reported using the *Standards*. One hundred ten teachers reported using the *LA Frameworks* compared to 30 who reported using the *Teacher's Guide to Assessment*. Comparing teachers' use of national and state documents, 149 teachers reported using a national document and 140 teachers reported using a state document. Obviously, these categories are not mutually exclusive.

Teachers' Use of Standards During Assessment Construction or Selection

Table 4.13 identifies the eight distinct categories that emerged from the data. Question 10 on the CAPQ asked teachers to "Briefly provide an example of how you use the science standards when constructing or selecting assessments". Thirty-five
percent of the teachers did not respond to the question. Category I contains teachers’
responses (16%) that focused on the relationship between the standards and the test

Table 4.12

Teachers’ Use of Specific Science Reform Documents (N=197)

<table>
<thead>
<tr>
<th>Document</th>
<th>Use</th>
<th>Do Not Use</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>%</td>
<td>N</td>
</tr>
<tr>
<td>National</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Science For All Americans</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>National Science Education Standards</td>
<td>30</td>
<td>60</td>
</tr>
<tr>
<td>Benchmarks for Science Literacy</td>
<td>43</td>
<td>85</td>
</tr>
<tr>
<td>State</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Louisiana Science Framework</td>
<td>56</td>
<td>110</td>
</tr>
<tr>
<td>Teacher’s Guide to Science Assessment Grades 4</td>
<td>15</td>
<td>30</td>
</tr>
<tr>
<td>8, and 10</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Regional</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Scienceworks</td>
<td>12</td>
<td>24</td>
</tr>
</tbody>
</table>

format. The responses were put into one of three subdivisions: (a) tests are developed
based on standards, (b) standards are used to justify tests, and (c) the response does not
indicate whether the test or the standard ‘came first’. The following examples are
offered to illustrate the kinds of responses that were grouped into Category I.

Category I (a) Examples:

Teacher: I model or pattern my assessment in the same format as the state
assessments.

Teacher: If the objective of the standard says list then I require them to do so
but if it says describe then open-ended essay questions or even an
experiment is used.
Teacher: LS-M-A1 “Describing the observable components and functions of cells, such as cell membrane, nucleus, and movement of molecules into and out of cells. (grades 5-8) objective: “students will recognize and describe parts and functions of cell organelles.” I would use the standard and have students learn functions of cell organelles. I would assess them in a higher level class by allowing them to write out function. In a lower level class I may use an objective test with m/c. In regards to a specific organelle that was elaborated on, I may choose to ask for an essay question (short one).

Category I (b) Examples:

Teacher: I arrange the standards where I can actually have students explain interpret and demonstrate what I want them to get out of the lessons taught.

Teacher: I always have a multiple choice related to the standard. I always include at least 1 essay to see if the students have an understanding of the concept being taught. The essay usually has them apply what they know.

Teacher: I use the science standards to make sure the pupils are exposed to different forms of assessment.

Category I (c) Examples:

Teacher: I try to give as many of the questions as I can in open ended style, that would reflect their knowledge of the specifics.
Teacher: Depending how the unit was taught I include a variety of assessments.

Table 4.13

Teachers' Use of Standards During Assessment Construction or Selection (N=197)

<table>
<thead>
<tr>
<th>Category</th>
<th>%</th>
<th>n</th>
</tr>
</thead>
<tbody>
<tr>
<td>I) Responses focus on the format of the test</td>
<td></td>
<td></td>
</tr>
<tr>
<td>A) Tests are developed based on standards</td>
<td>9</td>
<td>17</td>
</tr>
<tr>
<td>B) Standards are used to justify tests</td>
<td>4</td>
<td>8</td>
</tr>
<tr>
<td>C) Response does not indicate whether the test or the standard 'came first'</td>
<td>3</td>
<td>6</td>
</tr>
<tr>
<td>II) Responses make a general statement linking standards to the assessment instrument</td>
<td></td>
<td></td>
</tr>
<tr>
<td>A) Standards are some type of general guide</td>
<td>4</td>
<td>7</td>
</tr>
<tr>
<td>B) Teachers rationalize use of standards because they are pressured.</td>
<td>13</td>
<td>26</td>
</tr>
<tr>
<td>III) Responses indicate that the standards are used to write lesson plans and objectives</td>
<td>6</td>
<td>11</td>
</tr>
<tr>
<td>IV) Responses do not address the issue of standards</td>
<td>5</td>
<td>10</td>
</tr>
<tr>
<td>V) Responses are not related to assessment</td>
<td>7</td>
<td>13</td>
</tr>
<tr>
<td>VI) Responses are specific examples of techniques used to correlate standards with assessment</td>
<td>10</td>
<td>20</td>
</tr>
<tr>
<td>VII) Responses indicate that teachers do not use standards in developing assessments</td>
<td>5</td>
<td>10</td>
</tr>
<tr>
<td>VIII) No Response</td>
<td>35</td>
<td>69</td>
</tr>
</tbody>
</table>

Teacher: I occasionally use the assessment techniques suggested in the North Louisiana Education Consortium's Science content standards when the material provided with the text seems inadequate.
Thirty-three percent of the responses were grouped together because the teachers made a general statement linking standards to the assessment instrument. The category was subdivided into two groups, one set of responses (4%) referred to using the standards as a general guide. The other set of responses (13%) seemed to rationalize using the standards because of external pressure. The following are examples of responses in Category II.

Category II (a) Examples:

Teacher: Just as a guide to make sure I meet requirements.

Teacher: I try to design my assessment to assess the benchmarks.

Category II (b) Examples:

Teacher: The principal makes us post benchmarks on the side of each 9 weeks exam problem.

Teacher: I make sure science standards are addressed on all test.

Category III included responses that indicated teachers used the standards to write lesson plans and objectives. These responses indicated that the teachers use the standards to write lesson plans and objectives and then their test is based on the objectives for each lesson. Six percent of responses were coded into this category.

Category III Examples:

Teacher: By getting my objectives from the science standards I use those objectives to construct my assessments.

Teacher: The assessments are based on what's taught in the classroom. What's taught is in turn influenced by science standards. The methods of assessment are chosen based on the teaching process.

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Teacher: I don't compare the standards to the assessment just the actual lessons.

Teacher: I construct my assessments according to my objectives; therefore correlating them to the standards.

Categories IV and V contain responses that either did not relate to the standards (5%) or did not relate to assessments (7%). An example of responses in Category IV, (do not address the issue of standards), is “I select some items or activities provided and include those on tests when administered as a way of assessing mastery of skills”. An example of responses grouped into Category V, (are not related to assessment) is: “I use the science standards to make sure students are getting the information they need in order to perform on their grade level”.

Ten percent of the responses gave specific examples of how teachers used the standards when constructing assessments. These responses were grouped together into Category VI. The following examples, and others like them, make up this category.

Category VI Examples:

Teacher: I use a lot of performance assessments which encourages higher level thinking. I also grade using rubrics so specific outcomes are clear. The performances assess the specific behaviors and concepts identified in the objective.

Teacher: Science standards stress a knowledge of "science processes" I have worked a "hands-on" portion into two of my major yearly assessments and plan more.
Teacher: I select assessment by what the science standards instruct us to teach the students for example if they are to know the digestive system - I give them a diagram and they are to label it.

Teacher: Read performance expectation and example of assessments for that particular benchmark. Then I construct or correlate assessment from other sources with the benchmark.

Five percent (10) teachers indicated that they did not use the standards when constructing assessments. The following examples illustrate the kinds of responses grouped into this category.

Category VII Examples:

Teacher: I really don’t use the standards for constructing assessments. I do not use any objective testing in science. I do use the science North Louisiana Education Consortium's Science Curriculum for ideas in teaching.

Teacher: I don’t

Teacher: I don’t use the standards to select assessment. Book test and extra material.

 Reported During Interviews

Availability and Use of Science Reform Documents

Table 4.14 shows the levels of science reform documents used by the participants in this study. During the interviews the researcher asked each of the teachers to identify national, state, regional or parish science reform documents. The
LA Frameworks and Scienceworks were the two documents most frequently used by these teachers.

Table 4.14

Availability and Use of Science Reform Documents Reported During Interviews

<table>
<thead>
<tr>
<th>ID</th>
<th>Science Reform Documents Used</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>National</td>
</tr>
<tr>
<td>T5A</td>
<td>O</td>
</tr>
<tr>
<td>T5B</td>
<td>O</td>
</tr>
<tr>
<td>T6A</td>
<td>O</td>
</tr>
<tr>
<td>T6B</td>
<td>O</td>
</tr>
<tr>
<td>T7A1</td>
<td>O</td>
</tr>
<tr>
<td>T7A2</td>
<td>O</td>
</tr>
<tr>
<td>T7B</td>
<td>O</td>
</tr>
<tr>
<td>T8A</td>
<td>X</td>
</tr>
<tr>
<td>T8B</td>
<td>O</td>
</tr>
</tbody>
</table>

Note. X = document is available and used; O = document is not available and is not used

Document Analysis

A total of eight tests, one from each classroom, were considered for analysis.

Each test was identified by using the teacher's code. For example, the test marked T8A was constructed by the eighth grade teacher whose code was T8A. The test given to the seventh grade class taught by two teachers was coded T7A.

Tests were analyzed according to a modified version of an assessment analysis plan offered by Project 2061. This was a four step process which included a preliminary phase, determining content alignment, examining the test format, and a
profile or summary. Prior to the application of this assessment analysis, the researcher reviewed the transcriptions of the classroom observations to determine whether during the teachers' “test rehearsals” the students practiced memorizing the answers for the test. If this was the case, the test was eliminated from the analysis because regardless of the content and format, if students practice memorizing questions and answers, the only student characteristic being measured is the student’s ability to recall information. At this point, 4 of the 8 tests (T5A, T5B, T7A, and T8B) were eliminated from further analysis. Also, due to unavoidable teacher absence, one of the sixth grade classes was taught for three days by a substitute using worksheets and other hand-outs provided by the regular teacher. And this same science class was cancelled on two of the next three days due to a school activity day schedule and an early release day for the students. Moreover, the test given to the students at the end of the unit of instruction was a book-test (T6B). Because of these circumstances, the decision was made not to include this test in further analysis, reducing the number of tests to be analyzed from 4 to 3. Based on the above initial overview, the following three tests were selected for further analysis: T6A, T7B, and T8B.

The next three steps included the content analysis, format analysis, and profile. The content analysis examined the link between the assessment and the teachers’ learning goals to determine content alignment. Additionally, the teachers’ learning goals were compared to national, state, and regional standards and benchmarks (see Appendix J for detailed comparison). As suggested by Project 2061, the content analysis addressed the following criteria: substance, sophistication, part/whole, coverage and extraneous content.
The format analysis was an estimate of how well the teacher’s test addressed the standards and benchmarks from the perspective of what is known about student learning and effective assessment. As suggested by Project 2061 the following four criteria are discussed: fit of the item format, important ideas, context and fairness, and usefulness. A profile, or summary, of each test follows each analysis.

**Assessment Analysis for T8A**

**Content Alignment.** The link between the test and the teachers’ learning goals was judged to be strong. There was also a strong match between the teachers’ learning goals and the benchmarks listed in national, state, and regional documents. Energy use, the unit topic, is considered an essential one and appropriate for eighth grade students (see Appendix J). The test reflects information from the section of the unit on thermal energy, which was the part of the unit observed by the researcher. The learning goal for thermal energy in the teacher’s lesson plan book reads “Investigating and describing the movement of heat and the effects of heat in objects and systems”; and, was the focus of her instruction for two weeks. Her statement duplicates the benchmark in the state frameworks coded as PS-M-C5. The regional document, *Scienceworks*, contains a slight variation on the same theme “Investigate the types of heat transfer (conduction, radiation, and convection)” (p. 59). And, in *Benchmarks* it is listed as, “Heat can be transferred through materials by the collisions of atoms or across space by radiation. If the material is fluid, currents will be set up in it that aid the transfer of heat” (p. 85).

The test addressed the substance of the benchmark, except for the subtle difference about convection currents aiding heat transfer and not being a method of
heat transfer. As noted in *Benchmarks* (AAAS, 1993), "Convection currents appear spontaneously when density differences caused by heating (conduction and radiation) are acted on by a gravitational field. (Though not in space stations, unless they are rotating.) But these subtleties are not appropriate for most 8th graders" (p. 85). This distinction is not noted in either the state or regional benchmarks.

In addition to being substantive, the test also reflects a level of sophistication appropriate for 8th grade students. The performance task, in Section IV of the test, challenged the students to use their problem solving skills to determine the temperature of a mixture of hot and cold water. Students had to design, conduct and explain the results of their experiment.

Furthermore, the test was designed to address the key benchmark noted earlier in the content analysis. Recall that all benchmarks in reform documents are written in sets, by topic. While the teacher designed an entire unit on "Energy Use" to address all the benchmarks in the set, this test was intended to address that part of the unit related to thermal heat. According to the teacher, some of the benchmarks in the set were taught and tested at an earlier time and some of them will be addressed at a later date.

The researcher could not identify any items that could be construed as extraneous to scientific literacy. However, in the energy activity the term kiloliters is used. While students may be able to determine that 1 kiloliter = 1000 liters, they would not have a real understanding of the quantity of water involved in the problem. Because of the complexity of the task, perhaps a more familiar unit of measure would be a better choice.
**Format Analysis.** As was previously noted, during the format analysis the following four criteria are discussed: fit of the item format, important ideas, context and fairness, and usefulness. The test began with 10 matching items. Students matched scientific terms with their definitions. Most educators would agree that it is appropriate to test declarative knowledge of scientific concepts using matching items (Marzano, 1998). Stiggins (1994) includes matching items as one type of forced-choice items, where forced-choice means that there is only one correct answer. Matching items, as well as multiple-choice items, can play a role in identifying students’ declarative knowledge. Declarative knowledge is described as information and often contains component parts (Marzano, 1998). Knowledge of density, for instance, requires a basic understanding of mass and volume, ratios and so on. Procedural knowledge, on the other hand, pertains to skills, strategies, and processes. Calculating the density of a substance, for example, requires the basic computation skill of division. These two categories, declarative and procedural knowledge, are highly interactive. However, matching items seem to be a straightforward and effective way to assess students’ declarative knowledge, especially factual knowledge.

The next 10 items included multiple choice and, while some items required the student to recognize terms and definitions, a few required the students to apply their understanding of heat flow and energy transformations. For example, items 11 and 21:

By rubbing your hands together when they are cold, you

a. use mechanical energy to decrease their thermal energy
b. convert mechanical energy into thermal energy
c. use thermal energy to increase their potential energy
d. leave their energy unchanged

A person cannot survive very long if an accident throws him into cold water because

a. body heat rises
b. water is a poor conductor
c. body heat is transferred to the water
d. water temperature is lower than air temperature

The four open-ended responses, in section three of the test, probed students’ ability to explain science phenomena. However, one item was judged by this researcher to have measured recall, and not reasoning, because it was practiced in class. The remaining three questions were novel and did challenge the students’ ability to explain natural phenomena in scientific terms. For example, item 24:

Explain how conduction, convection and radiation have a part in creating our weather.

Two performance tasks were included on the test. One activity was “on-demand” the day of the test; but, the other activity was done at home and brought to school on the day of the test. For the take home activity, the students were asked to design, build and test a ‘shoe box insulator’ that would keep an ice cube from melting for as long as possible. The day of the test, they brought their shoe boxes to class and answered questions related to their experiment.

Does the test content reflect the big ideas of science? The concept of energy transformations is recognized as a very important idea, particularly in the “Designed World” where so much of man’s efforts go into designing more efficient machines (AAAS, 1989). Eighth grade students are certainly aware of the rate at which energy
is being consumed all around the world. Many of them are aware, too, of the rising cost of energy use. Helping them to learn about energy transformations and how to use insulation to restrict heat flow seems worthwhile from both a technical and social standpoint.

Items that used contextual clues, were judged to be fair and easily understood by all of the students (or misunderstood equally by all students). A possible exception may be that some students did not understand the meaning of “manufacturing process”. Next time the test is given, changing the context of this one question to something more familiar to these students might be helpful. Or the teacher could add another problem testing the same idea but in a different context and then allow the student to choose between the two problems. The language of the test was clear and readable at an eighth grade level.

Does the test provide information that would be useful to the teacher or the student? The test results could be interpreted from a variety of viewpoints. High scores on sections one and two combined with low scores on the performance task may indicate that students are still trying to memorize their way through school. These students may need to learn metacognitive skills. Conversely, a student with high performance scores and low knowledge scores, may need help to understand that learning and using terms with shared scientific meanings facilitates communication. The student’s performance in section IV could be used to evaluate his overall ability to do scientific inquiry; and, individual parts could provide information about the students’ ability to design, carry out, draw conclusions, and communicate results.
Test Profile. Overall this test demonstrated a close alignment with the standards and benchmarks in both content and format. The strength of the test lies in its variety of test items and the attention paid to assessing students' science inquiry skills. Weakness could be detected in the actual construction of the multiple choice test items. Sadler (1998) suggested that students' misconceptions be used as distracters in multiple choice questions. It might also be useful to replace some of the definition items with items that allow students to identify examples and non-examples of heat transfer processes and energy transformations.

Assessment Analysis for T7B

Content Analysis. The link between the assessment and the teachers' learning goals was strong in some areas and weak in others. The link between the teacher's learning goals and the standards and benchmarks is not as strong as the link between the teacher's goals and the test. This test was the fourth nine weeks test given to seventh grade students. The teacher requested that the researcher schedule classroom observations to coincide with the several class periods devoted to the students constructing their dinosaur projects and the nine weeks test.

The strongest link that ties the teacher's learning goals, the test, and the benchmarks together is the common link to earth and space science. Specifically written in the teacher's lesson plans, "The learner will (TLW) design, depict an environment based on previous models and examples that shows the Mesozoic era and accurately draw plants, geology murals, and food chain. (ESS M B2) AND (ESS M B1)". The benchmarks referenced in the teacher's plans are taken from LA Frameworks.
ESS M B1 – investigating how fossils show the development of life over time;

ESS M B2 – devising a model that demonstrates supporting evidence that the Earth has existed for a vast period of time (p. 44).

The weakest link is related to the life science benchmark. According to the teacher’s lesson plans: “TLW construct a symmetric vertebrate skeleton model (LS M A5)” and “TLW apply prior knowledge to draw a dinosaur based on skeleton model (LS M A5)”. The complete benchmark is

LSMA5 – investigating human body systems and their functions (including circulatory, digestive, skeletal, respiratory) (p. 36).

This benchmark related to investigating human body systems is clearly not the benchmark to use when students are articulating a dinosaur skeleton or drawing the dinosaur.

One section of the test requires that the student select one of three cartoons and explain how the cartoon related to the topic listed above the cartoon. The topics, listed by the teacher, included: earth time line or dinosaurs, volcanoes or plate tectonics, and the rock cycle or earth time line. The teacher’s learning goal that corresponded to this item was, “TLW explain geologic science principles related to crust, volcanoes and mountains (ESS M A1; ESS M A2; ESS M A3; ESS M A6)”. The benchmarks, referenced in the teacher’s plans are taken from LA Frameworks and include:

ESS M A1 – understanding that the Earth is layered by density with an inner and outer core, a mantle, and a thin outer crust
ESS M A2 – understanding that the Earth’s crust and solid upper mantle are dividing plates that move in response to convection currents (energy transfers) in the mantle

ESS M A3 – investigating the characteristics of earthquakes and volcanoes and identifying zones where they may occur

ESS M A6 – explaining the processes involved in the rock cycle

Another section of the test was a crossword puzzle “Geologic Time Scale Vocabulary Puzzle”. The vocabulary puzzle tested students ability to recall terms related to geologic time based on definitions or examples.

Are the cartoons addressing the specific substance of the benchmark or is there only a general “topic” correspondence? “Understanding” of concepts is the focus of benchmarks ESS M A1 and ESS M A2 and therefore could be addressed by the responses elicited by the cartoons. However, there is a question concerning the match between the response elicited by the cartoons and “investigating” and “explaining” in benchmarks ESS M A3 and ESS M A6. The level of sophistication seems appropriate for assessing middle school students.

The researcher did not identify any items that could be construed as extraneous to scientific literacy. Indeed, both comics and crossword puzzles appear in daily papers and are read by millions of readers. A scientifically literate adult should be able to find the humor in these cartoons.

Format Analysis. The test included three distinct formats: a vocabulary puzzle, explaining how cartoons relate to earth science, and an oral presentation of a dinosaur poster project. The puzzle is an appropriate way to evaluate students’ ability
to match geologic time vocabulary to their definitions or the examples provided. The cartoons seemed to evaluate at the level of understanding and application of selected science concepts. The lack of a scoring rubric for each cartoon makes it difficult to understand the teacher’s vision of the cognitive level at which the students were being tested. The scoring rubric attached to the test was used for evaluating the students, oral presentation of their “dino project”. The weakness in the oral presentation format was in the time limit. One minute did not give the students enough time to elaborate on their understanding of the science concepts involved in the project. Nor was there time for questions or discussion.

Does the test content reflect the big ideas of science? It was clearly the teacher’s intent to address one of the big issues in earth history, specifically, “how fossils provide important evidence of how life and environmental conditions have changed” (NRC, 1996). However, ‘fossils’ was reduced to dinosaurs and even the food chain concept was reduced to “who ate what”. The cartoons were clearly related to the big ideas of plate movements and the major geological events, such as earthquakes and volcanic eruptions, that result from these motions.

The items were judged to be fair; biases directed toward gender or race were not detected. The usefulness of this test as a whole is doubtful because the test results will not be seen by the students except as a letter grade on the report card. It might have been more useful to use the cartoons and the project earlier in the nine weeks which would allow the students to receive feedback. The scoring rubric used by the teacher was returned to the students so that they could add their self-evaluation.
However, as mentioned before, the time frame was too limited for any real benefit to
the student.

**Test Profile.** Overall this test demonstrated a partial alignment with the
standards and benchmarks in content and a more complete, but not strong, alignment
with the format. Its strengths lie in the high level of student interest and involvement.
The teacher must be applauded for her creativity, enthusiasm, and ability to maintain a
high interest level among seventh grade students. However, for all the work and effort
that was put into the creating and the taking of this test, there was less educational
payoff for all those involved because the timing of the test limited effective feedback.
Neither the teacher nor the student received adequate feedback for the amount of time
consumed by this test and the associated dinosaur project.

**Assessment Analysis for T6A.**

**Content Analysis.** The link between the test and the teachers’ learning goals
was judged to be incomplete. This was due to the lack of written lesson plans. The
following three learning goals were copied from the chalkboard by the researcher: (a)
TLW use a simple balance to weigh air, (b) TLW experiment to discover what
happens when hot and cold air come together, and (c) TLW construct a concept map
to review concepts about the Earth’s atmosphere. There is a partial content alignment
between the test and national standards and benchmarks. Topically T6A focuses on
the nature of earth’s atmosphere. The *Standards*’ authors focus on the atmosphere as
one of the four major components of the earth system. Both of the two key
benchmark for this test are listed under Earth and Space Science:
• "The atmosphere is a mixture of nitrogen, oxygen, and trace gases that include water vapor. The atmosphere has different properties at different elevations."

• "The sun is the major source of energy for phenomena on the earth’s surface, such as the growth of plants, winds, ocean currents, and the water cycle. Seasons result from variations in the amount of the sun’s energy hitting the surface, due to the tilt of the earth’s rotation on its axis and the length of the day" (p. 160).

This test did not address the substance of the benchmarks in that the concept of atmosphere was treated as discrete information. The topic of the atmosphere could have been located within a broader context as one part of a four part earth systems (NRC, 1996) or as it affects local weather and global climates (AAAS, 1993; DOE, 1997). Moreover, when compared to the Benchmarks, this test lacks a degree of sophistication. The authors of Benchmarks identify the concept of air as a substance that takes up space in the benchmarks for students in grades 3-5, “Air is a substance that surrounds us, takes up space, and whose movement we feel as wind” (p. 68).

The researcher could not identify any items that could be construed as extraneous to scientific literacy. However, memorizing the names of the layers and their exact placement on a diagram, may not be necessary in the sixth grade with students who are still not sure that air is really a substance.

Format Analysis. The four criteria discussed in this section are: fit of the item format, important ideas, context and fairness, and usefulness. This 13 item quiz was divided into three parts. In Part 1 students were asked to match the definitions with the terms. Part 2 consisted of six multiple choice items. And, Part 3, asked students
to match the layers of the atmosphere listed on the left with the diagram on the right. Each of the questions, regardless of the format, only tested the students’ ability to recall information either from the textbook or class discussions. While the “test rehearsal” was the construction of and discussion of the student’s concept maps, they were sent home with a “traditional” short answer study guide. Most of the test questions were simply the matching or multiple choice form of the short answer questions on the study guide. At this point, the researcher realized that further analysis was not warranted.

**Test Profile.** Overall this 13 item quiz demonstrated only a partial alignment with the standards and benchmarks in content, and no alignment in format.

**Students’ Opportunity to Learn the Material in Science Content Standards Reported by Teachers in the Questionnaire.**

A basic premise of the national science assessment standards is that assessing students’ opportunity to learn science is as important as assessing student achievement (NRC, 1996). However, there does not seem to be a consensus among researchers as to which indicators are the most useful when measuring students’ opportunity to learn (Wiley & Yoon, 1995; McDonnell, 1995; Porter, 1995; Ruiz-Primo, Ayala, & Shavelson, 1999). In the CAPQ students’ opportunity to learn was operationally defined by a set of questions related to (a) sources of teachers’ assessment knowledge, (b) instructional materials used in the classrooms, and (c) teachers’ use of science standards when planning for instruction.
**Sources of Teachers' Assessment Knowledge**

Teachers' knowledge about assessment comes from a variety of sources including college courses (undergraduate and graduate) and inservice programs offered at the state or district level. One item on the CAPQ instructed the teachers to darken the circle next to each assessment type that they learned to select, construct, and/or interpret in college courses. Table 4.15 shows that at least half of the respondents learned about objective tests, tests provided with textbooks, standardized tests, performance assessments, and oral questioning through courses taken in college. About one-third of the respondents learned about concept maps, science lab practicals, and portfolios.

Teachers were asked to rate the contribution of several sources as to how each one contributed to their knowledge of selecting, developing and interpreting classroom assessments on a Likert like scale from 1 = no help to 5 = significant contribution. The percentages and frequencies are given in Table 4.16. The responses indicated that the only source that was consistently marked as significantly influential was "experience as a teacher". None of the 197 respondents marked "no help" for this source. And 94% of the respondents marked it as a 4 or 5. A majority, 54%, of the respondents indicated that "experience as a student" made significant contributions as a source of assessment information. The remaining sources received conflicting reviews. About one third of the teachers rated them 1 or 2 (little or no help) and about one third of the teachers rated them as a 4 or 5 (significant contribution).
Table 4.15

Sources of Teachers' Assessment Knowledge (N=197)

<table>
<thead>
<tr>
<th>Assessment Method</th>
<th>%</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Learned in College</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Objective tests</td>
<td>94</td>
<td>186</td>
</tr>
<tr>
<td>Tests provided with textbooks</td>
<td>76</td>
<td>150</td>
</tr>
<tr>
<td>Standardized tests</td>
<td>66</td>
<td>130</td>
</tr>
<tr>
<td>Performance assessments</td>
<td>58</td>
<td>115</td>
</tr>
<tr>
<td>Oral questioning</td>
<td>50</td>
<td>99</td>
</tr>
<tr>
<td>Concept maps</td>
<td>34</td>
<td>66</td>
</tr>
<tr>
<td>Science lab practicals</td>
<td>34</td>
<td>66</td>
</tr>
<tr>
<td>Portfolios</td>
<td>33</td>
<td>64</td>
</tr>
<tr>
<td>Other</td>
<td>5</td>
<td>9</td>
</tr>
<tr>
<td><strong>Learned During Inservice Programs</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Objective tests</td>
<td>61</td>
<td>121</td>
</tr>
<tr>
<td>Tests provided with textbooks</td>
<td>59</td>
<td>116</td>
</tr>
<tr>
<td>Standardized tests</td>
<td>53</td>
<td>104</td>
</tr>
<tr>
<td>Performance assessments</td>
<td>41</td>
<td>81</td>
</tr>
<tr>
<td>Oral questioning</td>
<td>34</td>
<td>67</td>
</tr>
<tr>
<td>Concept maps</td>
<td>33</td>
<td>65</td>
</tr>
<tr>
<td>Science lab practicals</td>
<td>31</td>
<td>61</td>
</tr>
<tr>
<td>Portfolios</td>
<td>27</td>
<td>53</td>
</tr>
<tr>
<td>Other</td>
<td>7</td>
<td>14</td>
</tr>
<tr>
<td>No response</td>
<td>3</td>
<td>5</td>
</tr>
</tbody>
</table>

Instructional Materials Used in the Classroom

Teachers were asked in the CAPQ to identify the primary resource they used to deliver science instruction and to identify the materials they used to enrich science instruction (see Table 4.17). Sixty-four percent of the teachers reported using a combination of textbook and activity modules to deliver science instruction, 21% reported using a textbook only, “other” (write-in responses) accounted for 13% of the responses, 2% used activity-based modules, and 1% reported using technology-based science program as the primary resource used to deliver science instruction.
Table 4.16

Teachers’ Estimates of the Contribution of Each Source of Assessment Information (N=197)

<table>
<thead>
<tr>
<th>Source</th>
<th>1 % (n)</th>
<th>2 % (n)</th>
<th>3 % (n)</th>
<th>4 % (n)</th>
<th>5 % (n)</th>
<th>Blank % (n)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Experience as a teacher</td>
<td></td>
<td>1(2)</td>
<td>7(9)</td>
<td>20(40)</td>
<td>74(145)</td>
<td>1(1)</td>
</tr>
<tr>
<td>Experience as a student</td>
<td>7(9)</td>
<td>14(27)</td>
<td>26(51)</td>
<td>32(62)</td>
<td>21(42)</td>
<td>3(6)</td>
</tr>
<tr>
<td>Inservice training</td>
<td>8(16)</td>
<td>14(27)</td>
<td>28(56)</td>
<td>26(51)</td>
<td>17(33)</td>
<td>7(14)</td>
</tr>
<tr>
<td>Undergraduate methods course</td>
<td>11(22)</td>
<td>24(48)</td>
<td>26(51)</td>
<td>22(44)</td>
<td>14(28)</td>
<td>2(4)</td>
</tr>
<tr>
<td>Undergraduate measurement course</td>
<td>18(35)</td>
<td>23(46)</td>
<td>28(55)</td>
<td>18(35)</td>
<td>11(21)</td>
<td>3(5)</td>
</tr>
<tr>
<td>Professional Conferences</td>
<td>23(46)</td>
<td>9(18)</td>
<td>17(34)</td>
<td>16(32)</td>
<td>15(30)</td>
<td>19(37)</td>
</tr>
<tr>
<td>Graduate measurement course</td>
<td>27(53)</td>
<td>9(17)</td>
<td>20(39)</td>
<td>13(26)</td>
<td>10(20)</td>
<td>21(42)</td>
</tr>
<tr>
<td>LaSIP workshops</td>
<td>25(50)</td>
<td>7(15)</td>
<td>13(25)</td>
<td>11(22)</td>
<td>21(41)</td>
<td>22(44)</td>
</tr>
<tr>
<td>LaSIP course</td>
<td>30(59)</td>
<td>3(6)</td>
<td>12(23)</td>
<td>11(22)</td>
<td>18(35)</td>
<td>26(52)</td>
</tr>
<tr>
<td>Other (write in)</td>
<td>3(5)</td>
<td></td>
<td>1(2)</td>
<td>1(2)</td>
<td>3(6)</td>
<td>92(182)</td>
</tr>
</tbody>
</table>

Note. Scale: 1 = No help through 5 = Significant contribution

Teachers reported using a wide variety of materials to enrich their science instruction. Sixty percent of the teachers reported using combinations of enrichment materials as shown in Table 4.17. Eight percent reported using video cassettes and manipulatives for enrichment, 7% reported using hands-on-kits, lab equipment and resource books for enrichment, and, 2% reported using videodisc programs and computer software programs to enrich their science curriculum.
Table 4.17

Instructional Materials Used to Deliver Science Instruction

<table>
<thead>
<tr>
<th>Resource</th>
<th>%</th>
<th>n</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Primary Resource Used to Deliver Science Instruction</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Combination textbook and activity-based modules</td>
<td>64</td>
<td>125</td>
</tr>
<tr>
<td>Textbook</td>
<td>21</td>
<td>41</td>
</tr>
<tr>
<td>Other</td>
<td>13</td>
<td>26</td>
</tr>
<tr>
<td>Activity-based modules</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Technology-based science program</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td><strong>Enrichment Materials Used in the Classroom</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Combinations of Materials</td>
<td>60</td>
<td>119</td>
</tr>
<tr>
<td>Video cassettes</td>
<td>8</td>
<td>16</td>
</tr>
<tr>
<td>Manipulative</td>
<td>8</td>
<td>15</td>
</tr>
<tr>
<td>Hands-on kits</td>
<td>7</td>
<td>14</td>
</tr>
<tr>
<td>Lab equipment</td>
<td>7</td>
<td>14</td>
</tr>
<tr>
<td>Resource books</td>
<td>7</td>
<td>13</td>
</tr>
<tr>
<td>Videodisc programs</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Computer software programs</td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>

Teachers’ Use of Science Standards When Planning for Instruction

It is important to understand what teachers meant when they said that they used science reform documents to plan instruction. To clarify what they meant, teachers were asked to provide an example indicating how they used the standards when planning for instruction. Table 4.18 identifies categories of ‘use’ that emerged from the data. Twenty-six percent (52) of the respondents did not respond to this item and 5% (9) of the teachers stated that they did not use standards when planning for instruction. The following examples, in the teachers’ words, indicate possible barriers to standards implementation (a) “I do not use the standards to plan because the book and the benchmarks don’t match. Most of the standards for the 6th grade level are not contained in the textbook.”, (b) “This year I have not used the science standards because I feel that it is not necessary for several reasons. Mainly, if I were to align the
curriculum from my book with standards, there is no money for supplies needed to
teach the way these concepts should be taught.”; and (c) “Students will need to
understand basic before we move into the standards.” Ten percent of the responses
were unclear.

Eleven percent (22) of the teachers gave specific examples of how they used the
standards when planning for instruction. Teachers’ examples were related to the state
standards or to specific curriculum guides used in their district and based on the
standards, as one teacher wrote, “I use the North Louisiana Education Consortium’s
Science Curriculum with objectives, activities, and assessments to decide what to
include, exclude or augment within my class”. It is also apparent that the teachers do
not clearly distinguish between standards and benchmarks, “I focus on a standard like
“recognize the nine planets and their order from the sun” (ESS-M-C2) and then
create several lessons on that standard. Like students might color and label a
worksheet, answer questions from a data table on planets, make a model, etc.”

Teachers reported using the science standards and benchmarks in the following ways:
(a) to relate strands and sub-strands, “The LA science standards determine what to
teach. I try to relate ideas from one strand and link to another. Example: blood
pressure to air pressure (Life to physical science)” (b) to develop lesson plans, “I
develop lesson plans in accordance with benchmarks and standards. (LS-M-A1)
Describing the observable components and functions of cells, such as cell membrane,
nucleus, and movement of molecules into and out of cells. (grades 5-8) objective:
“students will recognize and describe parts and functions of cell organelles.”; (c) to
identify specific learning objectives for their students, “Using the science standards
listed in a discipline, I develop specific objectives from the goals derived from the benchmarks: Ex. LS-M-C1 (Classification system based on structure) yields the specific objective 'Identify three common protests and cite examples'; (d) to make decisions about which instructional strategies to use “I use the criteria set by the standards such as give examples, analyze, characterize, differentiate, explain, communicate, etc., to determine if it will be oral discussion, listing through brainstorming, a hands on lab or debating and essays”; and, (e) to make sure that material included on state and national tests is taught in the classroom, “Read dimension, identify benchmark to be taught, read expected performance and assessment examples.

Table 4.18

Use of Standards When Planning Instruction Reported by Teachers

<table>
<thead>
<tr>
<th>Category of Use</th>
<th>%</th>
<th>n</th>
</tr>
</thead>
<tbody>
<tr>
<td>I) Specific example given</td>
<td>11</td>
<td>22</td>
</tr>
<tr>
<td>II) Central focus</td>
<td>5</td>
<td>9</td>
</tr>
<tr>
<td>III) Choose objectives from standards</td>
<td>6</td>
<td>12</td>
</tr>
<tr>
<td>IV) Use standards as a guide</td>
<td>11</td>
<td>22</td>
</tr>
<tr>
<td>V) Use standards to plan lessons</td>
<td>7</td>
<td>13</td>
</tr>
<tr>
<td>VI) Correlate standards to Textbook</td>
<td>8</td>
<td>15</td>
</tr>
<tr>
<td>VII) Correlate standards to Lesson plans</td>
<td>9</td>
<td>17</td>
</tr>
<tr>
<td>VIII) Correlate standards to State or national tests</td>
<td>4</td>
<td>7</td>
</tr>
<tr>
<td>IX) Do not use standards</td>
<td>5</td>
<td>9</td>
</tr>
<tr>
<td>X) Response not clear</td>
<td>10</td>
<td>19</td>
</tr>
<tr>
<td>XI) No response</td>
<td>26</td>
<td>52</td>
</tr>
</tbody>
</table>

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Select appropriate activities and audio-visual materials, CD ROMs, and other resources to be used to achieve the benchmark, identify ways to correlate with other disciplines”.

Fifty percent of the teachers did not give specific examples, but indicated a general use of the standards in the following ways: (a) central focus, “From the beginning I marked the areas I need to teach after having a science meeting with my coworkers to see what others teach and make sure all standards are being taught. Design my lessons to make sure all standards are met”; (b) choose objectives from standards, “I review the standards, choose an objective based on the standards, then choose activities that correlate to the standards.”; (c) use standards as a guide, “I read the benchmarks and standards to get a starting point. Then, I look at the LA Science Framework and plan my lesson and the supporting activities from other resources (textbooks, trade books, videos, computer, etc.); (d) use standards to plan lessons, I use science standards when selecting the appropriate lessons to teach to my fifth grade class. I try to select units that will relate to the science standards; (e) correlate standards to textbooks, “I provide a study guide for each chapter with the benchmarks that apply to that chapter listed at the top. The study guide questions are based on those benchmark statements.”; (f) correlate standards to lesson plans, “I try to correlate what I already teach with the standards.”; and, (g) correlate to state or national tests, “I use the benchmarks to make sure I teach items that are required of ITBS testing.”
Teachers' Views on Science Teaching and Learning

Reported by Teachers in the Questionnaire

Data were collected using four open-ended questions in the CAPQ. Three questions asked respondents to (a) briefly describe how learning occurs, (b) to explain the student's role in learning, and (c) to explain the teacher's role in learning. A fourth item, designed to elicit teachers' views on the teacher's role as it specifically relates to students' alternative conceptions, used the following prompt: "Some people have suggested that many students develop their own ideas to explain nature, and sometimes their explanations can be substantially different from the scientific theories. What do you think about this suggestion?"

Recall that in the vision of science teaching and learning called for in the National Science Education Standards (NRC, 1996) students are actively engaged in the process of learning. This active learning process must be both mental and physical. Additionally, in Science For All Americans (AAAS, 1989) an entire chapter focused on the principles of learning in general, and of science learning in particular. A topic outline of this chapter is in Appendix K. Data were unitized, categorized, and analyzed according to the methods described by Lincoln and Guba (1985).

Teachers' Views on How Learning Occurs

Six distinct categories of teachers' views on how students learn emerged from the data and are reported in Table 4.19. Six percent (13) of the responses were grouped together because the meaning of the response was not clear and another category included the 47 questions (24%) that were not answered by the respondents. Of the remaining four categories, the first method may be described as participation in
an activity. Thirty-seven percent of the responses indicated that learning occurred when students were actively involved in learning. Not unexpectedly, these teachers had differing opinions on what a student was doing when s/he was “actively involved” in the classroom context. Involvement was variously described as learning by doing, by repetition, and by reinforcement. Learning was accomplished through experiences and activities. Responses were included in this category if the concept of physical activity was noted but there was no mention made of mental effort by the student being required. The following responses, and others similar to these, were grouped together under the title “learning through participation”:

Example: I feel that learning occurs by being actively involved in the process. The more physical activities that they do, the more retention they will have of the subject matter.

Example: I feel that learning occurs best through hands-on activities. When the students are able to "do" the experiments and procedures, they are able to "see" and "learn" the results.

The second category included responses that specifically mentioned the need for students to manipulate ideas by making connections between concept, between concepts and experiences, or linking new ideas to prior knowledge. This researcher identified twenty responses (10%) that met the criteria. Examples of responses which specifically indicated the need for mental activity included:

Example: Learning occurs when a person takes new concepts and associates or relates it to past or background knowledge.
Table 4.19

Teachers’ Views on How Learning Occurs (N=197)

<table>
<thead>
<tr>
<th>Teacher’s View</th>
<th>%</th>
<th>n</th>
</tr>
</thead>
<tbody>
<tr>
<td>I) Learning as a result of physical activity</td>
<td>37</td>
<td>72</td>
</tr>
<tr>
<td>A) Learning by doing</td>
<td>13</td>
<td>26</td>
</tr>
<tr>
<td>B) Learning by repetition, reinforcement</td>
<td>3</td>
<td>6</td>
</tr>
<tr>
<td>C) Learning from experience</td>
<td>7</td>
<td>14</td>
</tr>
<tr>
<td>D) Learning through senses and activities</td>
<td>13</td>
<td>26</td>
</tr>
<tr>
<td>II) Learning as a result of mental activity</td>
<td>10</td>
<td>20</td>
</tr>
<tr>
<td>A) Idea association</td>
<td>3</td>
<td>6</td>
</tr>
<tr>
<td>B) Linking prior knowledge</td>
<td>7</td>
<td>14</td>
</tr>
<tr>
<td>III) Person-associated learning</td>
<td>15</td>
<td>30</td>
</tr>
<tr>
<td>A) Teacher</td>
<td>4</td>
<td>8</td>
</tr>
<tr>
<td>B) Learner</td>
<td>10</td>
<td>16</td>
</tr>
<tr>
<td>C) Interaction between teacher and the learner</td>
<td>3</td>
<td>6</td>
</tr>
<tr>
<td>IV) Active learner participation</td>
<td>7</td>
<td>15</td>
</tr>
<tr>
<td>V) Not clear</td>
<td>6</td>
<td>13</td>
</tr>
<tr>
<td>VI) No response</td>
<td>24</td>
<td>47</td>
</tr>
</tbody>
</table>

Example: I believe learning occurs when knowledge is explored, manipulated, and connected to prior knowledge.

Thirty percent of the responses were related in that each response clearly identified a teacher, a student or an interaction between teacher and student as necessary for learning to occur. Responses, including the ones below and others similar to them, were grouped under the heading “person-associated learning”.

Example: Learning is an interaction that takes place between two individuals. If the relationship is a good one learning is easily accepted and can occur.
Example: Learning occurs when there is teaching.

Example: Learning must come “from within”. Students must have desire/interest in subject matter.

The fourth category included responses indicating that learning occurred as the result of both mental and physical activity by the student. This category contains responses that most closely resemble the vision of science learning set forth in the science standards. A total of 15 responses (7%) met the criteria including the following responses.

Example: Learning occurs through a process of discussion, relating what is known to what will be learned and hands-on experience. Students should be given the opportunity to tell what they know and use manipulatives to actually see what is happening.

Example: Learning occurs when the learner makes a lasting connection between the abstract and the concrete. After being exposed to a variety of stimuli, the learner categorizes and connects information and concepts to be used and assimilated into everyday life.

Example: Learning occurs when students are given an opportunity to think and write critically. Design experiments, make observations, and come to conclusions. Work in an cooperative setting.

**Teachers’ Views on the Teacher’s Role in Learning**

Results reported in this section are based on teacher responses to the item: “Briefly explain the teacher’s role in promoting learning.” Teacher responses were initially coded using the teachers’ wording. Data were categorized and re-categorized.
until the grouping could account for all of the responses. The groups were named to indicate the reason for group membership. The eleven resulting categories are listed in Table 4.20.

Seventy-five percent of the teachers answered this question, 25% did not respond. Two percent (4) of the responses were grouped together because the meaning of the responses was not clear to the researcher. Six percent (11) of the responses described one role of the teacher as evaluator. Responses grouped into this category were related to providing students with feedback and/or evaluating or assessing students' knowledge or performance. Examples included in this category follow.

Example: The teacher's role in promoting learning are: #1. To inform the students of the objectives. #2. Provide information that will support those objectives. #3. Fun loving activities that will support the objectives. #4. Provide feedback. #5. Assess students performance.

Example: The teacher must gain students' respect and attention. Then present material in an interesting way. Which can be done by various new innovative ways. Positive feedback and encouragement are a part of it as well. Assessment should reveal learning and retention of material.

Example: Teachers assess the growth of students learning. Teachers and parents communicate about student work. Teachers should collaborate with other teachers to reflect on their instructional program.
One of many teacher roles described in the *Standards* included providing for the proper social and intellectual environment necessary to foster a community of learners. The importance of providing an environment conducive to learning was noted by 5% (9) of the teachers. The following examples, and others similar to them, were grouped together in the category named “provider of the proper learning environment”.

Example: If I create a safe, challenging, and encouraging environment I hope to reach the majority of students. I believe my job is to teach academics but also responsibility through my classes.

Example: My role is to motivate students to learn and provide a positive learning environment.

A general category emerged to accommodate responses that did not fit into any other category, but did identify at least one teacher role. Three percent (6) of the answers were included in this group. The following responses, and others similar to them were included in the category named “general”.

Example: Promote higher order thinking.

Example: Teachers make decisions to affect students' intent to learn, the pace of learning and the retention of that learning.

The next category included responses describing the role of a teacher as guide or facilitator. Nine percent (18) of the responses described the teacher as a guide, 10% (20) as a facilitator, and 5% as both guide and facilitator. Only 2% (4) of the teachers specifically referred to “guiding the students using scientific inquiry”. The following
examples are in the teachers words and serve to illustrate the kinds of responses in each category.

**Table 4.20**

**Teacher's Role in Promoting Learning Reported by Teachers (N=197)**

<table>
<thead>
<tr>
<th>Teacher's Role</th>
<th>%</th>
<th>n</th>
</tr>
</thead>
<tbody>
<tr>
<td>I) Evaluator</td>
<td>6</td>
<td>11</td>
</tr>
<tr>
<td>II) Provider of the proper learning environment</td>
<td>5</td>
<td>9</td>
</tr>
<tr>
<td>III) General</td>
<td>3</td>
<td>6</td>
</tr>
<tr>
<td>IV) Guide and facilitator</td>
<td></td>
<td></td>
</tr>
<tr>
<td>A) Guide only</td>
<td>9</td>
<td>18</td>
</tr>
<tr>
<td>B) Facilitate only</td>
<td>10</td>
<td>20</td>
</tr>
<tr>
<td>C) Guide and facilitate</td>
<td>5</td>
<td>9</td>
</tr>
<tr>
<td>D) Guide/facilitate learning through scientific inquiry</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>V) Motivator</td>
<td></td>
<td></td>
</tr>
<tr>
<td>A) Motivation</td>
<td>6</td>
<td>11</td>
</tr>
<tr>
<td>B) Motivation and knowledge</td>
<td>14</td>
<td>28</td>
</tr>
<tr>
<td>VI) Presenter of information, facts, explanations</td>
<td>6</td>
<td>11</td>
</tr>
<tr>
<td>VII) Role model</td>
<td>4</td>
<td>7</td>
</tr>
<tr>
<td>VIII) Use a variety of teaching strategies</td>
<td>4</td>
<td>8</td>
</tr>
<tr>
<td>IX) Complex</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>X) Not clear</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>XI) No response</td>
<td>25</td>
<td>50</td>
</tr>
</tbody>
</table>

Guide only: Gentle guidance- I'm a tour guide.

Facilitator only: The teacher's role should be the facilitator or leader of learning, pointing students in the direction of science theory and knowledge.
Guide and facilitator: The teacher role is as a facilitator or guide in the learning process. Teachers are instrumental in how the student learns. I believe in teaching people not academics.

Guide through scientific inquiry: The teacher's role is to guide and encourage the students through their own investigations so that they learn by doing.

Six percent (11) of the responses identified the teacher as a motivator and 14% (28) recognized the teacher as a motivator who is also responsible for helping students acquire knowledge. Responses indicated that knowledge could be acquired from a variety of sources. The National Science Education Standards (NRC, 1996) suggests that teachers use inquiry into authentic questions and at the same time guide students in acquiring and interpreting information from a variety of sources including (but not limited to) the teacher, texts, data bases, experts, videos, and computer simulations.

The following examples serve to illustrate the kinds of responses within each group:

**Motivation:** The teacher's role in promoting learning is to be prepared and find various ways to motivate learning.

**Motivation and knowledge:** Teachers must be knowledgeable. Teachers should give clear directions, be enthusiastic, a doer. Provide a variety of learning experiences (method, techniques to make learning possible) Teachers must be organized and make great preparation for lessons to develop concepts and skills. Teachers must be an active motivator. Teachers should be creative using
various resources. Teachers must be great disciplinarians and must love what they do.

Six percent (11) of the responses highlighted the role of the teacher as a presenter of information, facts or explanations. These responses were grouped into the sixth category. The following items are representative of the responses in the category.

Example: Teachers promote learning by presenting ideas and information which can easily be added to the students knowledge base.

Example: A presenter of the material. Someone that will spark the interest of the students. The teacher should lead them or inspire them to search out knowledge.

In the vision of science teaching and learning set forth in the science standards, the concept of "role model" is used in the sense of the teacher being a representative of the science community at large (NRC, 1996). In this capacity the teacher models the skills needed for inquiry, exhibits enthusiasm and interest, and speaks to the power and beauty of scientific understanding. Additionally, the teacher who acts as a role model of the scientific community, demonstrates respect for differing ideas, attitudes, and values. Four percent (7) of the responses were grouped into the category named "role model". The next two examples, and others similar to them, were included in this group.

Example: A teacher is an important role model for students. Students want to believe everything the teacher says. As such I think that the teacher's views affect students learning. If the teacher does not
like science and voices this opinion the students will adopt the same belief. I think a teacher should be open to new ideas and should be enthusiastic and display a positive attitude toward learning.

Example: The teacher's role in promoting learning is of great significance. The teacher needs to model and let students know what is expected of them.

Authors of the science standards (NRC, 1996) suggested in the teaching standards that teachers use varied groupings, varied tasks and a variety of resources to help students achieve science literacy. Four percent (8) of the teachers who responded indicated that one role of the teacher was to use a variety of teaching strategies to meet the needs of individual learners. Two of the teachers also mentioned using small groups and peer grouping techniques. The following examples are offered to indicate the kinds of responses included under the heading “use a variety of teaching strategies”.

Example: Teachers should use a variety of teaching strategies and activities to facilitate learning; so that those students who want to achieve will be able to be a productive citizen.

Example: Teachers should use a variety of methods of instruction to promote learning: lecture, hands-on activities/labs, peer grouping.

Example: The teacher should adjust to individual students' needs. Not all children learn through lecture so the teacher should be able to
address the content area in different ways. Hands-on is one of my favorite ways to teach.

The following responses reflect the complexity of the teacher's roles as set forth in the science standards. For that reason these three responses were grouped together in a category named "complex". Clearly, the teacher has many roles to play in the classroom. These are the only responses in this category. They represent 2% of the total number of responses.

Example: Oversee hands on activity, group participation, science investigation, work on models or simulations. Lead science discussion - set up computer (Internet) as a resource and monthly field trips.

Example: The teacher should provide materials, equipment and an environment that will enhance learning. The teacher should have high expectation performances of the students, carefully plan appropriate activities that allows students to become actively involved in science. Often opportunities for science concepts, application and process skills to be connected with the real world and explore how science and technology affect student lives and society. Good classroom management skills are also necessary to promote learning.

Example: The teacher's role is to expose students to the knowledge that is available to them. Then guide your students to discover information for themselves. By doing this we give them the ability
to be learners for life. It is also important to teach the social skills that accompany working with others!!

Teacher's Role as It Relates to Students' Alternative Conceptions

Table 4.21 shows the categories that emerged as a result of this analysis. Of the 197 teachers who returned their questionnaires 31% (61) did not respond to the prompt: "Some people have suggested that many students develop their own ideas to explain nature, and sometimes their explanations can be substantially different from the scientific theories. What do you think about this suggestion?" In the vision of science teaching and learning recorded in the National Education Science Standards (1996) it is important for teachers to challenge students' current beliefs and concepts and to provide scientific explanations as alternatives.

Three percent (5) of those responding disagreed with the notion that students come to school with varying degrees of information. In nine cases, the researcher noted that the teachers' responses neither agreed nor disagreed with the statement nor suggested either teacher or student actions to be taken, and so these responses were put in a separate category.

Sixty-two percent (122) of the responses indicated that students arrived at school with varying levels of understanding about science concepts. These statements of agreement were further divided by the researcher using the following criteria: (1) response included a simple statement of agreement, (2) agreement, plus indicated a teacher action and a student action, (3) agreement, plus teacher action, (4) agreement, alternative conception should be addressed, but does not indicate how or by whom, and (5) agreement, but indicates that no problem exists.
Table 4.21

Teacher's Role Related to Student's Alternative Conceptions (N=197)

<table>
<thead>
<tr>
<th>Category</th>
<th>%</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>I) Teacher's response expresses a simple agreement with the statement.</td>
<td>23</td>
<td>46</td>
</tr>
<tr>
<td>II) Teacher's response indicates agreement with the statement, indicates that the students' ideas be honored, and requires the student to back them up with evidence and/or explanations.</td>
<td>7</td>
<td>13</td>
</tr>
<tr>
<td>III) Teacher's response indicates agreement with the statement and indicates that the teacher needs to take action by presenting the students with correct information, steering them in the right direction, or keeping them on track.</td>
<td>11</td>
<td>22</td>
</tr>
<tr>
<td>IV) Teacher's response indicates agreement with the statement and indicates that the misconceptions should be cleared up, but does not indicate how or by whom.</td>
<td>5</td>
<td>10</td>
</tr>
<tr>
<td>V) Teacher's response indicates agreement with the statement but indicates that there is no problem.</td>
<td>16</td>
<td>31</td>
</tr>
<tr>
<td>VI) Teacher's response indicates disagreement with the statement that students have their own ideas or that the students' ideas are incorrect</td>
<td>3</td>
<td>5</td>
</tr>
<tr>
<td>VII) Teacher's response neither agrees nor disagrees. Response does not seem related to the question.</td>
<td>4</td>
<td>9</td>
</tr>
<tr>
<td>VIII) No response/no opinion</td>
<td>31</td>
<td>61</td>
</tr>
</tbody>
</table>

By applying these criteria it was determined that 23% (46) of the teachers' responses indicated simple agreement, 7% (13) indicate agreement and require the student to back up ideas with evidence, 11% (22) agree and adds that the teachers should take action to redirect the student, 5% (10) agree with the statement, acknowledges a need for action, but does not indicate what action or by whom, and 16% (31) responses indicated that while students hold alternative ideas, that there is no need for teachers to address those ideas. This might be an area of concern because
research has shown that students' alternative conceptions are deeply rooted and resistant to change.

**Teacher's Views on the Student's Role in Learning**

Of the 197 teachers who returned questionnaires 32% (62) did not respond to the prompt: “Briefly explain the student’s role in promoting learning”; and, 2% (3) of the answers were not clear (see Table 4.22). Nineteen percent (37) teachers viewed a good attitude as an important student role. The following examples and others like them were grouped together in the category “have a good attitude”.

Teacher: The student must be willing. He/she will have to put forth effort. The student must be cooperative with teacher and peers. I feel learning is a two party situation. The learner/teacher must connect.

Teacher: The students must be somewhat self motivated. They must have a desire to know and not let set backs such as criticisms from peers or adults hold them back.

Teacher: A student must want to learn and understand the importance of an education before learning will begin. A student can also be a positive role model for another student.

Teacher: Positive attitude and self motivation are necessary components to promoting learning.

Sixteen percent of the responses indicated that student should be actively engaged mentally and physically, these were grouped together in a category and labeled “active learner”. Examples from this group included:

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Teacher: The student must have a desire to learn or improve in science. They should bring materials needed (paper and pencil) and completed assignment and/or projects to class. Students should be willing to participate in activities and follow classroom management skills. They should not be afraid to ask questions and/or perform further investigation or exploration.

Teacher: The student's role is to actively participate in class discussions, activities, assignments, projects, and reading. They are encouraged to explore the Internet whenever possible and to bring in information to share.

Table 4.22

Student’s Role in Learning Reported by Teachers (N=197)

<table>
<thead>
<tr>
<th>Category</th>
<th>%</th>
<th>n</th>
</tr>
</thead>
<tbody>
<tr>
<td>I) Have a good attitude</td>
<td>19</td>
<td>37</td>
</tr>
<tr>
<td>II) Active Learner</td>
<td>16</td>
<td>32</td>
</tr>
<tr>
<td>III) Engage in mental activity</td>
<td>14</td>
<td>28</td>
</tr>
<tr>
<td>IV) Engage in physical activity</td>
<td>8</td>
<td>15</td>
</tr>
<tr>
<td>V) Passive learner</td>
<td>5</td>
<td>9</td>
</tr>
<tr>
<td>VI) Help others learn</td>
<td>4</td>
<td>8</td>
</tr>
<tr>
<td>VII) Related to assessment</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>VIII) Not clear</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>IX) No response</td>
<td>32</td>
<td>62</td>
</tr>
</tbody>
</table>

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Teacher: To listen, participate (written, oral), complete class and homework. To work with peers in co-op groups in problem solving and experimentation. To communicate with teacher, parent and peers during the process of learning.

Teacher: Prepared, focused, motivated. Realizing it is up to them to meet their potential. Studying, and they are the ones that must see, hear, and do the things to get the information. They have to actively participate for learning to occur.

The next category was labeled “engage in mental activity”. Responses were included in this category if they only referred to mental activities. Fourteen percent (28) responses were grouped together. The following examples, and others like them, were included in this category.

Teacher: Students need to have or cultivate a sense of interest and knowledge that scientific literacy makes them better people. Students need a learning and work ethic. Students should also expand their imaginations and nurture those as well.

Teacher: The student should actively listen, think about what is said, both ask and answer questions, and actually do their homework and study for tests.

Eight percent of the responses (15) referred to a generic “active” aspect of learning or to physical activity, but not mental activity. The following examples highlight teachers’ views of a generic need for activity.
Teacher: The student must be actively engaged in order for learning to occur.

Teacher: The student needs to be an active learner. In return, the student is promoting their own learning as well as other students.

Five percent of the responses focused on student helping other students to learn. One of the following responses expresses the view that students relate better to each other. The other response refers to “peer tutoring”.

Teacher: The student’s role in promoting learning is an important one. When other students see an understanding of a certain concept, they too have a better chance of learning it. Sometimes, students relate better to one another which I feel promotes learning.

Teacher: Students should lead discussions and should be responsible for guiding learning. (When in groups) They should also get a chance to peer teach because they learn best from each other.

Two percent of the responses mentioned assessment as being an important student role in promoting learning. The first response relates the student’s role to studying for tests and using feedback. The second example mentions the role of students in writing test questions.

Teacher: Student must have a desire and interest in learning. Participate in activities and assignments. Learn proper study techniques for testing and use feedback constructively.

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Teacher: My students participate in discussions. They are encouraged to tell experiences of places and things they have done. Many of my students are military so I have wide range experiences. My students write test. I then use some of their questions in my own tests.

In the following chapter the results presented in this chapter will be organized, discussed and summarized to begin to address the research questions which formed the basis for this study. Classroom assessment practices will be discussed in terms of (a) achievement targets, assessment methods and the matches between them and (b) the frequency of selected assessment activities. The influence of science standards on teachers’ classroom assessment practices will be examined by (a) identifying factors having the most influence on teachers’ decisions to use particular assessment methods, (b) determining the availability and use of science reform documents by teachers, and (c) discussing teacher-generated examples of how they use standards in constructing and selecting assessments. Finally, teachers’ views on science teaching and learning will be discussed as they relate to the vision of science teaching and learning set forth in the Standards and students’ opportunity to learn the science content in the reform documents will be summarized.
DISCUSSION

Classroom Assessment Practices of Middle School Teachers

Although the analyses presented in this study begin to address the question "What are the classroom assessment practices of middle school science teachers?" they provide only one perspective on this multi-faceted question, and many other studies are required to provide a more complete picture. Data from the questionnaire, classroom observations, and teachers' lesson plans were analyzed to identify and describe teachers' achievement targets, the methods they used to assess the targets, and the appropriateness of the matches teachers made between achievement targets and assessment methods. Questionnaire data were also used to describe the frequency of selected classroom assessment activities.

Achievement Targets, Assessment Methods and the Matches Between Them

Three major categories of classroom achievement targets were identified through classroom observation including student achievement, student attitudes and student products. Student achievement included both science content and science processes. Science content included knowledge and understanding of science concepts, principles, laws, and theories. Science processes included those abilities related to inquiry, reasoning, and communicating. For these teachers student attitudes included students' personal and social development. The distinction between students' personal and social development was based on definitions offered by Bell and Cowie (1997). Students' personal development is related to their metalearning. Students' social development is related to their interacting with others in the classroom. The final category included student products and projects.
The achievement targets that were observed being assessed by the teachers in this study were similar to those identified in the *National Science Education Standards* (1996). According to the *Standards*, teachers collect data to describe and quantify student achievement and student attitudes. Furthermore, the *Standards* recommend that achievement data collected should focus on the science content that is most important for students to learn. This important science content includes: (a) the ability to inquire, (b) knowledge and understanding of scientific facts, concepts, principles, laws and theories, (c) the ability to reason scientifically, (d) the ability to use science to make personal decisions and to take positions on societal issues, and (e) the ability to communicate effectively about science.

The researcher did not observe, in any of the eight classes, teachers assessing students’ ability to use science to make personal decisions or to take positions on societal issues. This may have been a matter of chance; but, it cannot be determined from this study whether teachers are engaging students in using their science knowledge to understand societal issues. And, while three of these teachers did assess students’ inquiry skills in a partial manner, none of the teachers required the students to undertake a full inquiry—from asking the question to reporting on findings. This may have been due, in part, to the age or experiences of the students. Or maybe the teachers were not comfortable with managing a full inquiry task.

As noted in Table 4.7, these teachers used a variety of assessment methods and similar types of assessment across grade levels. They were also observed to use different assessment methods when assessing different achievement targets. These findings disagree with an earlier study on teachers’ classroom practices which reported
that teachers did not change their assessment methods when changing the achievement targets (Stiggins & Conklin, 1992) and with a study by Gullickson (1985) that indicated significant differences exist among assessment techniques used at different grade levels. However, the Gullickson study compared elementary teachers to secondary teachers, and this study examined the assessment practices of 5th, 6th, 7th, and 8th grade teachers. Furthermore, the data for the Stiggins & Conklin (1992) study were collected in 1989, before the national and state science reform efforts had time to affect classroom practices. It is possible that one result of the reform efforts in Louisiana is an increase in the number of teachers using multiple forms of assessment; and, changing the type of assessment depending on the achievement target. Louisiana was awarded a ten million dollar federal grant and the state matched the award. This grant money was used to educate teachers about math and science reform efforts and some of the results may now be visible in the classrooms of some teachers. Each of the three teachers whose instruction and assessment practices were most closely aligned to the standards had participated in at least one Louisiana Systemic Initiative Project (LaSIP) university program.

When assessing science content teachers across grade levels, in addition to traditional paper and pencil tests, used oral questioning, teacher demonstrations, and class discussions. Teacher-directed activities seemed to dominate the assessment of science content. However, a notable exception to this was the use of concept mapping by one teacher to assess students' knowledge. Concept mapping was clearly a student-centered activity. When assessing science processes, teachers used more student-centered assessment methods. These methods included observations, written
records, collaborative grouping to engage in partial inquiry activities, and oral student reports. These teachers' assessments focused on students' ability to make predictions, draw conclusions and communicate their results in a variety of ways (i.e., orally and in writing, using graphs as well as text).

When assessing student attitudes, teachers used personal communication, checklists and student self-assessment forms. Teachers' assessment of the social and personal development of their students was either planned or unplanned. For the most part, planned assessment relied on the use of checklists and forms and unplanned assessments were usually personal communications.

Evidence of student products and projects were displayed on the walls in many classrooms. Though not observed to be assessed by every teacher, one of the two teachers who were observed scoring student products and projects used a written scoring rubric which included a self-assessment by the student. However, the students' self-assessment was not written on the scoring guide itself. The teacher returned the scoring guides that she had used to score the projects and gave verbal directions to the students to "tell me what you liked best and what you would do differently". The other teacher, in her first year of teaching, said her scoring system was "in her head" and mentioned during an interview that her system included how well the students worked together, and whether they had acquired the correct number of facts and pictures for the project. The current status of classroom assessment described in Blueprints-On-Line (1998) included the following statements, "Evidence suggests that because teachers do not receive proper training in effective assessment methods, they tend not to change the methods they use as assessment needs change."
Different assessments are needed to measure performance, effort, and achievement, for instance, but teachers tend to use the same type of assessment to measure all three. Both the quantitative and qualitative data collected during this study indicate that this trend may be changing. Based on this study there is reason to believe that many middle school science teachers do use different assessment methods to measure different achievement targets.

The quantitative data (see Table 4.4) support the qualitative findings previously discussed. The quantitative data show that the majority of teachers used essay questions to assess students' science content knowledge (52%) and students' ability to reason (51%), used performance assessment to evaluate students' process skills (62%) and products (65%), and used personal communication to assess students' attitudes (81%). Clearly, these percentages indicate that the respondents are changing the methods they use as their assessment needs change.

It is generally agreed that different types of assessments are best suited to different kinds of achievement targets. Although you can assess most types of student learning targets by most methods, there are some more and less efficient ways to do it (Stiggins 1992, 1997). A modified version of Stiggins' (1992) original model was used to examine the appropriateness of the matches between achievement targets and assessment methods reported by teachers in the CAPQ (see Table 4.5) and observed in teachers' classrooms (see Table 4.8). It was found that many teachers are using appropriate methods to assess student learning. For example, teachers reported using essay questions to assess student content knowledge (52%) and reasoning skills (51%) and according to Stiggins (1997), essay questions can be employed effectively to
assess not only knowledge, but the use of reasoning skills as well. The majority of the teachers reported using appropriate matches between performance assessments and science process skills (62%) and products (65%); and, between personal communication and student attitudes (81%).

Areas where teachers are using less appropriate methods, when judged against the modified Stiggins model, include using selected response questions and essay questions to assess information literacy skills and foundation literacy skills. The problem may lie in the interpretation of the term “skills”, rather than reflecting a truly inappropriate match between method and target. Both Stiggins and the teachers value using performance assessment to assess students’ science process skills. The discrepancy comes when grouping the LA content standards foundation skills and the information literacy skills for lifelong learning under the “skills” category. The LA content standards foundation skills include: communication, problem-solving, resource access and utilization, linking and generating knowledge, and citizenship. Information literacy is defined in the LA Frameworks (DOE, 1997) as, “the ability to recognize an information need and then locate, evaluate, and effectively use the needed information” (p. 5). The information literacy model for lifelong learning focuses on the following abilities: defining and focusing, selecting tools and resources, extracting and recording, processing information, organizing information, presenting findings, and evaluating efforts. It may be more informative to either separate and then redistribute the individual ‘skills’ under different achievement targets or add two more achievement targets to the list: communication skills and lifelong learning skills.
Frequency of Selected Classroom Assessment Activities

Survey instruments can address questions regarding the frequency with which selected practices are used by teachers, under the assumption that teachers and the researcher interpret the names or descriptions of the practices in the same manner (NCES, 1999). This assumption may be tenuous, however. Teachers may have quite different ideas about the kind of practice that is meant by a given survey item, depending on the grade they teach, their experience with the practice or similar practices, and the training they have received in the practice. Furthermore, the current popularity of some assessment methods among reformers may create incentives for teachers to overestimate the frequency with which they use recommended assessment practices. Therefore, the data are probably most useful as indicating general trends of teacher use rather than precise estimates of the percentage of all teachers who used a particular practice.

Teachers reported the frequency with which they used various assessment activities during science classes (see Table 4.6) using a 5-point scale with the following response categories: “never,” “rarely, a few times a year;” “sometimes, once or twice a month;” “often, once or twice a week;” and “all or almost all science classes.” The assessment activities were grouped into two aspects of assessment: teacher activities and student activities.

One interesting way to look at the data is to identify those assessment activities that teachers’ reported in the “never” and “rarely” categories. For purposes of this discussion, the categories were combined. Three assessment practices were related to teacher activities. Twenty-three percent of the teachers reported never/rarely using
assessment to find out what students know before or during a unit, 11% reported not embedding assessment in regular class activities, and 38% reported never/rarely reading or commenting on reflections students wrote in journals or notebooks. Of these three activities, two of them have been standard assessment/instruction practices. Assessing what students know before teaching a unit has been called diagnostic testing; and, assessing students during a unit of instruction has been called continuous monitoring of student learning. Furthermore, the term “embedded assessment” may be new, but for many years effective teachers have observed students engaged in instructional activities and used the information gathered to estimate what the students knew and were able to do.

Helping students become more reflective and thereby more responsible for their learning through journaling is one of the recommendations made by both national and state science reform documents (NRC, 1996; DOE, 1997). While 38% may seem like a large number of teachers to never/rarely read students’ reflections, the way the item was worded may have been misleading. Both teachers and students confuse “journaling” about personal issues with “journaling” about learning. To some teachers reading students’ personal journals would be an invasion of privacy, but what was intended by the question was “journaling” in the sense that the student was reflecting on what s/he learned, how it fit with their previous knowledge of a science topic and what science concepts or relationships between concepts were still confusing to them. The value of a teacher reading these journals would be that the teacher could then help the students resolve conflicts through direct instruction, or offer experiences or ways
of thinking about a problem that would help the student overcome his or her difficulties.

Alternatively, is there any evidence to indicate that the three teacher activities just discussed play a part in regular classroom assessment/instruction (Table 4.6)? When asked how often they used assessment before or during a unit of instruction, 16% of the teachers reported assessing almost every class period, 26% of the teachers reported at least once or twice a week, and 34% reported assessing students before or during a unit once or twice a month. Responding to the item asking about the use of embedded assessments 42% percent of the teachers reported embedding assessments in regular class activities once or twice a week, 14% almost every class period, 30% reported once or twice a month. In reporting the frequency with which they read or commented on students’ journal entries, 29% of these teachers reported at least once a month, 20% reported once or twice a week, and 11% indicated reading and commenting on student journals daily. Clearly the data indicate that some teachers do report using the following teacher assessment activities as part of their “regular practice” (a minimum of once or twice a month): (a) use assessment to find out what students know before or during a unit, (b) embed assessment in regular class activities, and (c) read/comment on reflections students write in journals or notebooks. These responses however, cannot tell us anything about the quality of the practices or other factors that affect the effectiveness of the practices (i.e. student engagement, administrative support, amount of time the teacher spends with students).

Other items focused on the frequency of selected student activities, reported by teachers, as an indicator of classroom assessment practices (see Table 4.6). And again
this researcher first looked at those student assessment actions that teachers reported never occurring in the classroom, or occurring only rarely. One item asked how often students wrote reflections in journals or notebooks. Teachers’ responses indicated that 37% of the students never or rarely wrote reflections. This seems to agree with the response noted earlier, that 38% of the teachers never or rarely commented on the reflections students write in their journals. In reporting students’ work on portfolios, 58% of the teachers responded that students worked rarely or never worked at all on portfolios. Not unexpectedly, only 2% of the teacher reported that their students never or rarely took selected response tests (multiple choice, fill-in-the-blank, matching); and, only 8% of the teachers reported never or rarely using tests requiring open-ended responses (descriptions and explanations). And 20% of the teachers reported that their students never or rarely engaged in performance tasks for assessment purposes. Both portfolios and performance tasks are time consuming and labor intensive which may be a big part of the reason that teachers report using them less frequently than more traditional assessment methods. As noted by Good (1999),

> We should be very careful not to overburden classroom teachers with paperwork, as some forms of assessment seem to do. Guarding against this problem as new forms of assessment are developed and field-tested is perhaps the biggest challenge facing the field of assessment reform (p. 353).

On the other hand, how often are these activities engaged in by students? Teachers’ responses indicated that some students are required to keep journals. Twenty eight percent of the teachers reported that students wrote reflections once a month, 19% reported once a week journaling, and 11% of the teachers asked students to write reflections daily. In reporting students’ work on portfolios, 21% of the teachers responded that students worked once or twice a month, 12% reported students
worked once or twice a week, and 6% indicated that students worked on portfolios daily.

When asked specifically about the frequency with which they used particular test formats, 51% of teachers reported that students engaged in selected response tests once a week, 28% engaged students in selected response tests once a month, and 17% used selected response tests on a daily basis. Responses to the item asking about the frequency of use for open-ended test items indicated that 46% of the teachers reported using tests requiring open-ended responses with their students at least once or twice a week, 34% once or twice a month, and 10% reported almost every class having students take tests requiring open-ended responses. Teachers reported using performance tasks less frequently than either selected response or open-ended items. Forty-one percent of the teachers reported engaging their students in a performance task at least once or twice a month, 27% once or twice a week, and 8% reported using performance tasks almost daily.

Based on the quantitative data supplied by teachers, it would seem that middle school students spend an inordinate amount of time taking tests of one kind or another. One possible explanation of this response from teachers is that much of their assessing is done verbally, in a quick continuous monitoring of student learning. On the other hand the fault may lie with the questionnaire. Because of the length of the questionnaire the teachers got distracted or became overly tired. And the way the question was worded did not lead to mutually exclusive categories. It may even be that teachers believe they give more tests than they actually give because (a) teachers must grade tests, in most cases, by hand and this labor intensive activity makes
teachers more aware of giving tests, (b) testing is a frequent topic of classroom
conversation between students and teachers and, (c) testing problems are often the
reason teachers and parents have conferences.

Did observations support the quantitative data on frequency of testing?
Classroom observations did not indicate that formal, written assessment was taking
place at this same rate. In seven of the eight classrooms, teachers engaged in
continuous monitoring, using a variety of techniques, and only one relied on daily
written "work" involving textbook questions and worksheets. Two of the teachers
used four or five written short answer questions, on one occasion in each room, to
monitor student learning before formally testing the students to see what they had
learned. Time between formal testing to measure what students had learned as a result
of instruction, varied by the teacher's teaching style and the science content being
taught. However, even if a science teacher gives a test once every two weeks, the
number of tests in core subjects for the student would average 5 tests every 10 days.

Of interest to the reader may be the question of whether secondary science
certified teachers (teaching in grades 5-8) differed in their classroom assessment
practices from elementary certified teachers. It was not the intent of this study to
compare groups, however, the 20 secondary science certified teachers in this study
were compared to the 151 elementary teachers and no significant differences were
identified. Tables containing the comparison data are located in Appendix L.

Assessment Record Keeping Strategies Used by Teachers

Classroom observations and teacher interviews revealed that teachers used a variety
of record keeping strategies including grade books, activity logs, folder systems,
scoring guides and forms for social skill development (see Table 4.9). Grade books kept by the teachers were either traditional grade books and/or electronic grade books. Most of the teachers who were required by their principals to keep both kinds of grade books believed that it was a waste of time to keep double records. But as one teacher said, “Since it is not unusual to go to school and find all of your grades have been wiped off the computer, a written record is a must”.

Activity logs were used by two of the teachers. These logs were typically one page long and provided by the textbook publisher. They provided a written record of the science activities engaged in by students. The logs contained the name of the activity or investigation and asked questions of the student, focusing the student’s attention on important concepts to understand and providing a place for the student to record predictions, hypotheses, data generated from the activity, results and conclusions. Frequently, one of the questions focused students attention on making connections to more general concepts. The teachers collected these logs and kept them for the students until they were needed. When the teachers were asked how they used the information recorded by the students on the activity logs, they responded that the information was used to determine if students understood the concepts or processes being taught.

Six of the eight teachers observed maintained a student folder system; although the specifics were different, the purpose was the same – to keep students from losing the written work they needed to study for a test or have signed as part of a school wide accountability system. Not surprisingly, the teachers who did not keep a student
folder system taught in a school whose principal did not require that student work be sent home, signed by parents, and then returned to the teacher.

While several teachers referred to scoring guides during interviews, only one teacher was observed to use a written scoring guide with her students. A copy of the scoring guide is located in Appendix I. One of the seventh grade teachers used a scoring guide to evaluate individual project presentations. Each student also used the same scoring guide to self-assess their own presentation. The teachers who reported during interviews using scoring guides also indicated that they were "in my head" and not written down.

Only two teachers were observed using written forms for tracking the development of students' social skills. One of the teachers used a checklist attached to a clip board. She made written notes on how well the students worked with each other in groups during science activities. It was important to this teacher that her students learn to work together. Her evaluation criteria were clear to the students; they knew what was expected of them as evidenced by the lack of discipline problems. Her recording keeping strategy allowed her to make multiple observations of each student over time. Using performance assessment as a tool for assessing students' social development gets the best results when the purpose is clear, criteria are clear and appropriate, multiple observations are made, students understand and value the purpose, and instructions are clear (Stiggins, 1997).

Another teacher used social skills development as a way to organize her students thinking about their own group work. One of the jobs built into her cooperative groups was "assessor". The teacher was able to clearly explain the "jobs"
for the students. She understood the need for both the purpose and the criteria of the assessment to be clear so that the student “assessor” could do an effective job. Current research and national reform documents support the idea that students need to understand the criteria by which they are evaluated (Morais & Miranda, 1996; AAAS, 1997).

The Influence of National or State Science Standards on Teachers’ Classroom Assessment Practices

To what extent do the national or state science standards influence CAPs? Three sources provided information on the extent to which the national or state science standards influenced middle school teachers’ CAPs: (a) questionnaire responses, (b) teacher interviews, and (c) document analyses of teacher-made tests. The questionnaire items of consequence were those which asked teachers to indicate factors having the most influence on decisions to select an assessment method, to record the availability and use of science reform documents and those which solicited teacher-generated examples of how they used standards for constructing and selecting assessments.

Factors Influencing Teachers’ Selection of Assessment Methods

Three of the 16 factors listed as influencing teachers decisions to select or construct a particular type of assessment were directly related to the influence of science standards. They were: (a) alignment of test content and format with national science standards, (b) alignment of test content and format with state/district standards, and (c) alignment of test content and format with state testing. Teachers reported that the three most influential factors considered when making decisions to select an assessment method were (a) how students learn, (b) alignment with
state/district standards, and (c) purpose for assessment (see Table 4.10). These results indicated that the state science standards are influential enough to be rated in one of the top three positions. Alignment of test content and format with state testing was ranked 6th and the alignment of test content and format with national science standards was ranked 11th. Part of the reason for this difference between the state and national standards may be that a greater number of teachers have access to state reform documents than national documents. Another possible reason is the emphasis placed at the district and school level on raising LEAP 21 test scores. The state LEAP 21 test is a criterion referenced test which measures the degree to which students have achieved the state science standards at grades 4, 8, 10 and 11. The factors at the bottom of the list were (a) time it takes for the students to complete the test, (b) time it takes for the teacher to grade the test, and (c) opportunity for students to evaluate the knowledge claims of others. These factors were ranked lower than the ones mentioned above; but, they still are important influences.

**Availability and Use of Science Reform Document**

Teachers who have copies of the science reform documents claim to use them (see Table 4.11). Responses indicated that about three fourths of the respondents possessed and used at least one of the science reform documents. However, nearly one fourth of the teachers surveyed reported not possessing and not using any of the reform documents. Questionnaire data also indicated that of the 150 respondents who reported using science reform documents 149 teachers reported using national documents and 140 teachers reported using state documents indicating that teachers
who use science standards tend to have and use more than one reform document (Table 4.12).

During the interviews the researcher asked each of the teachers which documents they possessed and used from among the national, state, regional and parish science reform documents. The LA Frameworks and Scienceworks and the local district’s concept grid were most often used by these teachers. One puzzling aspect to this researcher was that teachers did not recognize the Teacher’s Guide to Science Assessment Grades 4, 8 and 10 (DOE, 1998). This was puzzling because the state sent copies to the school principals and the district also sent copies, along with a directive from the superintendent requiring principals to copy and distribute the assessment documents. As the interviews progressed the researcher discovered that only part of the complete document had been distributed to each teacher. Moreover, only the eighth grade teachers saw any value in the document. The 5th, 6th, and 7th grade teachers were mainly concerned with the content and format on the ITBS test taken by their students at the end of the school year.

**Teacher-Generated Examples of Standards Use in Assessment Construction and Selection**

Teachers were asked in the CAPQ to “Briefly provide an example of how you use the science standards when constructing or selecting assessments”. The eight distinct categories that emerged from the data are listed in Table 4.13. Thirty-five percent (69) of the teachers did not respond to the question so we do not know how or whether they used the science standards when constructing or selecting assessments. Additionally, 5% (10) teachers indicated that they did not use the standards when constructing assessments. What information about standards use can be gleaned from
the remaining 60% (118) of the responses? Twenty five percent (49) of the remaining
responses were statements that did not relate standards to assessment selection or
construction or indicated that teachers were paying lip service to the standards because
they were pressured to do so.

The remaining 35% (69) of the responses indicated that some teachers are
using the standards in the selection and constructing of classroom assessments. The
most direct use of the standards reported was to select content, format and cognitive
level for test items. A more circumspect approach used by teachers was to use the
standards to write lesson plans and objectives and then to plan assessments based on
these teacher-constructed objectives. The problem created by doing this is that the
"big ideas" of the standards are reduced by the specific, measurable objectives that
many teachers are required to write. The resulting assessment may become one that
focuses on factual data devoid of the rich context envisioned in the standards,
reinforcing students' conceptions of science as a body of knowledge to be memorized.

Alignment Between Standards and Teacher-Made Tests

It must be noted that all of the teachers who were observed believed that they
planned their instruction and their assessment to align with the science content
standards. Not unexpectedly, the manner in which each teacher translated the
standards into her teaching and assessment strategies was different. Even the most
traditional of the teachers, who believed in straight rows and busy, quiet students,
working individually, had the parish concept grid in her lesson plan book and assured
me during an interview that every thing she taught was based on the standards. And
she was correct in that, topically, her lesson plans and test did address the science
concepts found in the parish concept grid. However, it is a major assumption of the National Research Council (1996) that, "The content standards must be used in the context of the standards on teaching and assessment. Using the standards with traditional teaching and assessment strategies defeats the intentions of the National Science Education Standards" (p.112).

A recurring assessment problem was that three of the eight teachers observed emphasized understanding of science concepts and engaged students in partial inquiry methods during instruction yet tested students on facts and recall. This finding is in agreement with a similar one reported by Canady and Hotchkiss (1989) who found that teachers emphasized higher order thinking skills during instruction yet tested students on facts and recall. It is important that this problem not be identified as "teaching to the test". These teachers clearly taught standards and benchmarks using recommended teaching strategies. However, they quite literally stopped teaching science after the unit test was constructed or selected and began to help students memorize questions and answers. This researcher has named this behavior "test rehearsal". This practice was observed to occur in both 5th grade classrooms and one 6th grade classroom. It is important to understand that each of these teachers would have been given "high marks" in terms of teaching appropriate science content using effective strategies. It was only when the researcher began to analyze the alignment among the standards, benchmarks, lesson plans and teacher-made tests that the disconnect between the quality of teaching and the quality of testing was recognized.

Three other kinds of assessment difficulties were identified in the remaining classrooms. Two of the assessment problems are related to the lack of effective
teaching strategies and the third is related to the lack of time spent in science class. In one of the 7th grade classes the teacher wrote outlines on the chalkboard and these were copied by the students. As the teacher went through the outline with the students she made every effort to make the class “interesting and fun”; but not very informative because she relied on the use of rote memory techniques such as mnemonics to help her students memorize information. It should also be noted that she was using notes taken from her college biology textbook and not using the textbook adopted by the school district.

The second assessment issue that was the direct result of ineffective teaching methods was observed in an 8th grade classroom. In this room the students sat in rows and were not allowed to talk at all. This 30 year veteran insisted on quiet. The only conversation in the room by the teacher centered on the correction of student behavior. The only other time the teacher spoke was to give directions and correct students’ written questions. Twice a week the students checked their work by reading out loud the answers to questions they had written during earlier classes. Students were expected to “work” and get “it” (correct answers) in class or at home. Worksheets were used daily. The unit test selected was that provided by the textbook publisher. The test questions had been asked and answered by the students on earlier worksheets. In order to “pass the test” students needed to memorize information from their worksheets. This teacher used an outdated textbook. It was not the textbook adopted for use by the school district.

The last issue revolved around the amount of time spent in science class. In one of the 6th grade classes the science class was either cancelled because of the
teacher’s professional leave or because the school activity schedule required the students to be out of class. It may be that this is not an assessment issue but an issue related to students’ opportunity to learn science content and surfaces when one reflects on why students may have earned low test scores.

The following matrix (Table 5.1) is offered as way to make visible an overview of the alignment found between standards and teacher-made tests. However, it should be noted that other researchers, with different science education backgrounds and different teaching experiences, might have different perspectives on these tests.

Table 5.1
Assessment Analysis Matrix

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Teacher-Made Test</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>T8A</td>
</tr>
<tr>
<td>Content Alignment</td>
<td></td>
</tr>
<tr>
<td>Substance</td>
<td>X</td>
</tr>
<tr>
<td>Sophistication</td>
<td>X</td>
</tr>
<tr>
<td>Coverage</td>
<td>P</td>
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<tr>
<td>Extraneous Content</td>
<td>O</td>
</tr>
<tr>
<td>Format analysis</td>
<td></td>
</tr>
<tr>
<td>Fit of Item Format</td>
<td>X</td>
</tr>
<tr>
<td>Important Ideas</td>
<td>X</td>
</tr>
<tr>
<td>Context and Fairness</td>
<td>X</td>
</tr>
<tr>
<td>Usefulness</td>
<td>X</td>
</tr>
</tbody>
</table>

Note: X = good alignment; P = partial alignment; O = not present; NE = not evaluated

Alignment between the tests used by teachers and Standards and Benchmarks was examined using a modified version of Project 2061’s Assessment Analysis. The content alignment included examining the link between the test and the teachers’ learning goals and the match between the teachers’ learning goals and the benchmarks listed in national, state, and regional documents. The purpose of the format analysis...
was to estimate how well the test addressed the standards and benchmarks based on the following criteria: the fit of individual item format, important ideas, context and fairness, and usefulness (see p.107 cf.).

Students’ Opportunity to Learn the Material in Science Content Standards

A basic premise of the national science assessment standards is that assessing students’ opportunity to learn science is as important as assessing student achievement (NRC, 1996). However, there does not seem to be a consensus among researchers as to which indicators are the most useful when measuring students’ opportunity to learn (Wiley & Yoon, 1995; McDonnell, 1995; Porter, 1995; Ruiz-Primo, Ayala, & Shavelson, 1999). In the CAPQ students’ opportunity to learn was operationally defined by a set of questions related to (a) sources of teachers’ assessment knowledge, (b) instructional materials used in the classrooms, and (c) teachers’ use of science standards when planning for instruction.

Teachers’ knowledge about assessment comes from a variety of sources including college courses (undergraduate and graduate) and inservice programs offered at the state or district level (see Table 4.15). Data indicate that the teachers reported learning about the same types of assessment in both college courses and in inservice programs. The percentage of teachers in each category (except for concept mapping which was equal) indicate that more teachers learned about all types of assessments more frequently in college than in inservice programs. One possible reason for this is that many district and state inservice programs focus on curriculum, instruction, and classroom management, rather than assessment issues.
Teachers were asked to rate the contribution of several sources as to how each one contributed to the teachers' knowledge of selecting, developing and interpreting classroom assessments on a Likert like scale from 1 = no help to 5 = significant contribution (see Table 4.16). “Experience as a teacher” was viewed by teachers as contributing significantly to their assessment knowledge. And “experience as a student” was viewed as making an important contribution to their assessment knowledge. The other sources of information: inservice training, undergraduate and graduate courses, LaSIP workshops and courses, and professional conferences and conventions can be grouped as making some contribution to teachers' assessment knowledge. One possible reason for this grouping is that “memory” is not always reliable. Another possibility is that there was no way on the CAPQ to indicate the quality of the experience the teacher had, i.e. a workshop on the same topic given by different presenters gives rise to totally different learning experiences for teachers.

The qualitative data indicates that teachers value LaSIP workshops and courses as sources of both instructional and assessment information. Each of the three teachers whose instructional and assessment practices were most closely aligned to the standards spoke of attending and valuing both LaSIP courses and workshops.

Another aspect of opportunity to learn is the materials used in instruction. Teachers must decide what materials they and their students will use as they teach and learn. Standards advocate a wide variety of instructional materials and technologies, but teachers must choose from the materials provided by their schools and school districts. In addition, teachers often resort to spending their own money to supplement

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the resources provided by districts and schools. Consequently, the materials that teachers use are a function of choices they make and choices made by others.

Teachers were asked in the CAPQ to identify the primary resource they used to deliver science instruction and to identify the materials they used to enrich science instruction (see Table 4.17). Sixty-four percent of the teachers reported using a combination of textbook and activity modules to deliver science instruction, 21% reported using a textbook only, "other" (write-in responses) accounted for 13% of the responses, 2% used activity-based modules, and 1% reported using technology-based science program as the primary resource used to deliver science instruction. The most interesting finding depicted in Table 4.17 is the movement away from the textbook as the primary and sometimes sole resource used by teachers.

Teachers also reported using a wide variety of materials to enrich their science instruction. Sixty percent of the teachers reported using combinations of enrichment materials as shown in Table 4.17. Eight percent reported using video cassettes and manipulatives for enrichment, 7% reported using hands-on-kits, lab equipment and resource books for enrichment, and, 2% reported using videodisc programs and computer software programs to enrich their science curriculum. This use of multiple resources reinforces the notion that there is a movement away from the textbook as the sole resource for science instruction.

Another indicator of students' opportunity to learn the material in the science content standards is to examine whether teachers use the content standards to plan science instruction. Table 4.18 shows categories of "use" that emerged from the data. From a total of 197 responses 26% of the teachers did not respond to the question, 5%
said that did not use standards when planning for instruction, and another 10% of the responses were unclear as to how the standards were used.

The following examples, in the teachers' words, indicate possible barriers to standards implementation (a) "I do not use the standards to plan because the book and the benchmarks don't match. Most of the standards for the 6th grade level are not contained in the textbook."); (b) "This year I have not used the science standards because I feel that it is not necessary for several reasons. Mainly, if I were to align the curriculum from my book with standards, there is no money for supplies needed to teach the way these concepts should be taught."); and (c) "Students will need to understand basic before we move into the standards." These teachers were not opposed to the content standards, they didn't seem to know how to implement the standards. The content standards alone are not enough to insure classroom implementation. Boone & Kahle (1997) reported a similar finding. According to their findings Ohio teachers and principals indicated that an understanding of the program and system standards underlies the implementation of the content standards.

Teachers who reported using the standards to plan instruction either gave a specific example of how they used standards or their response was a general reference to standards use. Teachers giving specific responses reported using the science standards and benchmarks in the following ways: (a) to relate strands and sub-strands, (b) to develop lesson plans, (c) to identify specific learning objectives for their students, (d) to make decisions about which instructional strategies to use and, (e) to make sure that material included on state and national tests is taught in the classroom. Fifty percent of the teachers did not give specific examples but indicated a general use
of the standards in the following ways: (a) used as a central focus, (b) used to choose objectives from standards, (c) used standards as a guide, (d) used standards to plan lessons, (e) to correlate standards to textbooks, (f) to correlate standards to lesson plans, and (g) to correlate instruction to state or national tests. Quantitative data indicate that teachers report using the standards and benchmarks in a variety of ways. Certainly many more studies will be needed to further describe these uses and to examine how using the standards in planning instruction is related to the use of standards in selecting and/or constructing assessments.

Teachers’ Views on Science Teaching and Learning

Highlighting the relationship among beliefs, classroom practices, and change Black and Wiliam (1993) suggested that the nature of each teacher’s beliefs about learning and the beliefs that teachers hold about the potential to learn of all their pupils are two basic issues that underlie some of the problems in changing teachers’ classroom practices. This perspective suggests that any serious effort to achieve the national goal of “science for all” involves paying attention to teachers’ views about how students learn science and the roles of both teachers and students in promoting science learning.

Data were collected on teachers’ views on science teaching and learning using four open-ended questions in the CAPQ. Three questions asked respondents to (a) briefly describe how learning occurs, (b) to explain the student’s role in learning, and (c) to explain the teacher’s role in learning. A fourth item was designed to elicit teachers’ views on the teacher’s role as it specifically relates to students’ alternative conceptions.
In the vision of science teaching and learning called for in the *National Education Science Standards* (NRC, 1996) students are actively engaged in the process of learning. This active learning process must be both mental and physical. Data analysis identified six distinct categories of teachers’ views on how students learn (see Table 4.19). Twenty four percent of the respondents did not answer the question and 6% of the responses were not clear. Thirty seven percent of the responses indicated that learning occurred through experiences and activities. Ten percent of the responses referred to the mental activity required by students, but did not address the issue of physical involvement in the learning process. Fifteen percent of the responses indicated that learning was associated with a person (teacher or student) or the interaction between teacher and student. Seven percent of the responses articulated a view of learning that was most aligned with that expressed in the *Standards*, specifically, that the learning process requires that students’ involvement be both physical and mental. The quantitative data indicate that some teachers are aware that students must be actively engaged in the learning process, though how they each define “active process” does vary.

How then do these teachers view the students’ role in this active learning process? Sixty eight percent of the respondents answered this question and 32% did not (see Table 4.22). A total of 38% of the teachers described the learners’ role in terms of mental and physical engagement. Another 19% of the responses added the need for the learner to have a good attitude and 4% responded that learners should help each other. The teachers who specifically mentioned that students had a role in assessment responded that students should be responsible for learning proper study
techniques for testing, using feedback constructively and helping to prepare test questions. Self-assessment was not mentioned by any of the teachers. Qualitative data also indicated that self-assessment was not widely used as part of middle school teachers classroom assessment practices. However, the Standards clearly call for students to accept and share responsibility for their own learning including student assessment of their own work.

The roles teachers must play in the classroom are as varied as they are complex. The eleven categories of teachers' roles obtained through data analysis are listed in Table 4.20. Seventy-five percent of the teachers responded to this item, 25% did not respond. Six percent of the responses included a reference to the teacher’s role as assessor or evaluator. These responses identified the role of teachers in providing students with feedback and/or evaluating their students’ knowledge and performances. They also referred to the need for teachers to communicate with parents about student work and the need for teachers to collaborate with other teachers to reflect on their instructional program.

One of many teacher roles described in the Standards included providing for the proper social and intellectual environment necessary to foster a community of learners. The importance of providing an environment conducive to learning was noted by 5% of the teachers. Another category included responses describing the role of a teacher as guide or facilitator. Nine percent of the responses described the teacher as a guide, 10% as a facilitator, and 5% as both guide and facilitator. Generally, the teachers were not specific about what they were facilitating or guiding. Only 2% of the teachers specifically referred to “guiding the students using scientific inquiry”.

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Six percent of the responses identified the teacher as a motivator and 14% recognized the teacher as a motivator who is also responsible for helping students acquire knowledge. Responses indicated that knowledge could be acquired from a variety of sources. The Standards recommend that teachers use inquiry into authentic questions and at the same time guide students in acquiring and interpreting information from a variety of sources including (but not limited to) the teacher, texts, data bases, experts, videos, and computer simulations.

Both the respondents and the authors of the Standards use the term “role model” to describe one of the roles that teachers enact in the classroom. However, there is a discrepancy between the way the two groups define the term “role model”. According to the Standards the concept of “role model” refers to the teacher as a representative of the science community at large (NRC, 1996). However, the 4% of the responses grouped into the category named “role model” referred to the teacher modeling what students were expected to learn and how they were expected to behave. Therefore, we cannot automatically assume that when teachers use the same vocabulary that is found in the Standards that they understand the term as intended by the Standards.

Authors of the Standards advocated, in the teaching standards, that teachers use varied groupings, varied tasks and a variety of resources to help students achieve science literacy. Four percent of the teachers who responded indicated that one role of the teacher was to use a variety of teaching strategies to meet the needs of individual learners. Two of the teachers also mentioned using small groups and peer grouping techniques.
The following discussion examines the teacher's role as it relates to students' alternative conceptions. Recall the recommendation from the National Education Science Standards (1996) that teachers challenge students' current inaccurate misconceptions and provide scientific explanations as preferred options. Do we have any reason to believe that the teachers who responded to this questionnaire share this vision? Table 4.21 shows the categories that emerged as a result of data analysis. Of the 197 teachers who returned their questionnaires 69% (136) responded to this item and 31% (61) did not respond. Sixty-two percent (122) of the responses indicated that students arrived at school with varying levels of understanding about science concepts. These statements of agreement were further divided by the researcher using the following criteria: (a) response included a simple statement of agreement, (b) agreement, plus indicated a teacher action and a student action, (c) agreement, plus teacher action, (d) agreement, alternative conception should be addressed, but does not indicate how or by whom, and (e) agreement, but indicates that no problem exists. By applying these criteria it was determined that 23% of the teachers' responses indicated simple agreement, 7% indicate agreement and require the student to back up ideas with evidence, 11% agree and adds that the teachers should take action to redirect the student, 5% agree with the statement, acknowledges a need for action, but do not indicate what action or by whom, and 16% of the responses indicated that while students hold alternative ideas, that there is no need for teachers to address those ideas. This might be an area of concern because research has shown that students' alternative conceptions are deeply rooted and resistant to change.
Summary of Findings

Research Question 1: What Are the Classroom Assessment Practices of Middle School Science Teachers?

Quantitative and qualitative data offer support for the following emerging picture of the classroom assessment practices of middle school science teachers. Certainly many more studies are required to provide a more complete picture.

1. Three major categories of classroom achievement targets were identified through classroom observations of eight middle school (5th, 6th, 7th, and 8th) classrooms, two classes at each grade: (a) student achievement, (b) student attitudes and, (c) student products.

2. Five of the eight middle school teachers in the qualitative phase of the study were observed assessing students' ability to do partial inquiry; focusing on making predictions, drawing conclusions, and reporting findings (orally and in writing).

3. The three teachers who were best able to align standards and benchmarks with sound assessment practices and effective instructional strategies had participated in at least one LaSIP university course.

4. These middle school science teachers used a variety of assessment methods and similar types of assessment across grade levels. Their non test assessment methods were more similar than different.

5. Most of these teachers were observed using different assessment methods when assessing different achievement targets, as recommended by Standards and Benchmarks.
6. Using a modified version of Stiggins' model to examine the appropriateness of the match between achievement target and assessment data, it was found that many teachers are using appropriate methods to assess student learning.

7. Three fourths of the teachers reported using assessment to find out what students know before or during a unit (a minimum of once or twice a month).

8. Eighty-six percent of the teachers reported embedding assessment in regular class activities (a minimum of once or twice a month).

9. Fifty-eight percent of the teachers reported that they read or commented on reflections students write in journals or notebooks (a minimum of once or twice a month).

10. Thirty-nine percent of the teachers reported that their students worked on portfolios in class (a minimum of once or twice a month).

11. Sixty-six percent of the respondents reported that their students take tests that include multiple choice, fill-in-the-blank, and matching items (a minimum of once or twice a month).

12. Ninety percent of the teachers reported that their students took tests requiring open-ended responses (descriptions and explanations) a minimum of once or twice a month.

13. Seventy-six percent of the respondents reported that their students engaged in performance tasks for assessment purposes, a minimum of once or twice a month.

14. Assessment record keeping strategies used by teachers in this study were limited to only a handful of strategies. The only record kept by all the teachers
was a traditional grade book. Their grade book pages were not set up based on standards; they reflected the traditional method of date, grade, and general description of graded activity. Besides the grade book, only half of the teachers were observed using activity logs, scoring guides, and forms for recording social development skills.

Research Question 2: To What Extent Do the National or State Science Standards Influence CAPs?

Using both quantitative and qualitative data from this study, what can we say about the influence of national and state standards on middle school teachers classroom assessment practices? The results of this exploratory study are just "baby steps" in the journey toward understanding how Standards influence teachers' practices. The data suggest the following:

1. Questionnaire data indicated that the three factors having the most influence on teachers' selection or construction of a particular type of assessment were (a) how students learn, (b) alignment with state/district standards, and (c) purpose for assessment.

2. Questionnaire data indicated that teachers who reported having science reform documents used them. Responses indicated that about three fourths of the respondents possessed and used at least one of the science reform documents. However, nearly one fourth of the teachers surveyed reported not possessing and not using any of the reform documents.

3. Teachers' reported using the standards during assessment construction or selection in a wide variety of ways. The most direct use of the standards reported was to select content, format and cognitive level for test items. A
more circumspect approach used by teachers was to use the standards to write lesson plans and objectives and then to plan assessments based on these teacher-constructed objectives.

4. The document analysis of three teacher-made tests indicated that Project 2061's Assessment Analysis is useful in examining the alignment of the teachers' tests with Standards and Benchmarks. Of the three tests analyzed, one had a strong content and format alignment with the Standards, one had a partial alignment with both content and format, and the remaining test had a partial alignment with the content.

**Sub Question 2a: Do Teachers Views on Science Teaching and Learning Support the Vision of Science Learning Set Forth in Science Reform Documents?**

1. Many teachers, 54%, clearly view learning as an active process. However, it is not clear exactly what they mean by “active process”. Some of the respondents wrote about physical activity and others wrote about mental activity being needed for learning. Seven percent of the respondents indicated the need for both mental and physical learner participation.

2. Teachers were less articulate about defining the students’ role in the learning process, although 38% of the teachers indicated that students must be active learners. Not unexpectedly, “active learner” had different meanings for different teachers. Mirroring the responses to the item on how learning occurs some teachers indicated that students should be physically, mentally, or both physically and mentally involved in the learning process. Only 2% of teachers recognized that students played a role in assessment as part of the learning process.
3. The teacher plays many complex roles in the learning process. While only 2% of the responses reflected the complexity set forth in the Standards, the majority of the teachers focused on at least one role that supports the vision of teaching and learning in the reform documents (e.g. establishing a proper environment, motivator, guide, facilitator, user of a variety of teaching strategies). On a cautionary note we should use care as we seek to understand what meanings teachers attach to their teacher roles.

4. While the Standards clearly state that one of the teachers’ roles is to challenge students’ alternative conceptions and help them develop a more scientific understanding of the world, teachers’ responses indicate that only 18% were in agreement with this view. However, many teachers (39%) recognized that students do hold views that are different from the views of the scientific community. An area of concern includes those teachers who do not think students alternative views constitute a problem and those who disagree that students have alternative conceptions.

Sub Question 2b: Are Teachers Providing Students With the Opportunity to Learn the Material in National or State Content Standards?

1. Data suggests that some teachers are using the science content standards to plan their science instruction. Specific examples of how teachers used the standards included: developing lesson plans, identifying specific learning objectives for students, making decisions about which instructional strategies to use, and making sure that material included on state and national tests is taught in the classroom. However, the quality of this use was beyond the
scope of this study. Nevertheless, only 5% of the respondents stated that they
did not use the standards to plan their science instruction.

2. Instructional materials used to deliver and enrich science instruction are varied
as suggested by the Standards. Responses indicate that there is a clear
movement away from the textbook as the sole source of science information.
As noted before, we must be cautious because we do not have an indication of
the quality of use of these materials.

3. Data indicate that colleges, universities, school districts and the state all need
to continue to address teachers' assessment knowledge. It is encouraging to
see that some teachers are receiving information about concept maps,
portfolios, performance assessments and lab practicals. However, the
percentages are still small compared to more traditional forms of assessment.

Suggestions for Science Teacher Educators

Findings related to identifying the CAPs of middle school teachers indicate
that many, but not all, teachers are able to appropriately match achievement targets
and assessment methods. Both the quantitative data and the qualitative data offer
support for this assertion. As teacher educators we need to continue our efforts to
offer opportunities for both pre-service and in-service teachers to broaden and deepen
their understanding of sound classroom assessment practices and their ability to
engage students in meaningful assessment activities as well as meaningful
instructional activities.

Are middle school students really suffering from test fatigue? Quantitative,
self-report data indicate that middle school students spend an inordinate amount of
time taking science tests. However, classroom observation data indicate that while many teachers are continuously monitoring student learning, most middle school students are not engaged in written science tests even on a weekly basis. But, on a cautionary note, these students are enrolled in multiple classes and it is reasonable to assume that five is the minimum number of tests the students are expected to take within a two week period. Test taking procedures are not uniform among schools and teachers need to be aware of the testing climate in their building from the students' point of view. If we want to encourage students to take more responsibility for their own learning, we certainly want to give them time to learn and practice without penalty. As teacher educators we can help teachers learn to challenge their students to accept and share responsibility for their own learning as recommended in both Standards and Benchmarks without adding to students' test fatigue. Giving individual students active roles in (a) the designing and implementation of investigations, (b) the preparation and presentation of work to their peers and, (c) students' assessment of their own work will encourage students accept responsibility for their own learning (NRC, 1996).

Findings from this study suggest that at least some of the problems with teachers' classroom assessment practices are related to ineffective teaching practices. Both pre-service and in-service teachers need time to discuss what it means to align their lesson objectives with the Standards and Benchmarks and with their own testing practices. In order to be effective teachers need the opportunity to study the Standards and Benchmarks and work with people in their districts and schools to help make local
curriculum decisions about which benchmarks will be taught at which grade and how attainment of the standards will be measured.

One of the most effective methods we can use as teacher educators is modeling. Teachers who are enrolled in university courses and inservice workshops need instructors and professors who model sound classroom assessment practices, effective teaching strategies, and encourage teachers to become responsible, life long learners.

Suggestions for Further Research

Assessment is a systematic and multistep process that involves: specifying the use to be made of educational data; deciding what data will be collected; determining how the data will be collected; interpreting the data; and making decisions and taking action informed by the data (NRC, 1996). While the findings from this study shed light on what data teachers collected and how the data was collected; it did not address how clearly teachers were able to specify the use to be made of the data or how well the teachers interpreted and used this data to make decisions about student learning. Further research is needed to investigate how well teachers interpret and use the assessment data they collect to make decisions about curriculum and the effectiveness of their teaching strategies as well as student achievement.

Teachers will need help learning to use assessment in new ways. If we are to achieve in the reality of the classroom the vision of science teaching and learning set forth in reform documents. Given that new ideas about the role of assessment will not be “matched” to current beliefs, teachers will need assistance to reflect on their own beliefs as well as those of students, parents and school administrators. Because
teachers' beliefs, knowledge and skills are pivotal in bring about change in assessment practices, teachers' knowledge and beliefs should be a primary site for research (Shepard, 2000).

Both quantitative and qualitative data indicate that middle school science teachers' classroom assessment practices are influenced by state science content standards and benchmarks, and to a lesser degree the national science content standards and benchmarks. However, the degree of influence varies from teacher to teacher. If we want to have a standards-based instruction/assessment program, we need to understand what happens to the “big ideas” of science as national content standards and benchmarks are converted into state content standards and benchmarks and then translated into teachers' lesson plan objectives. Research studies need to be designed to test a variety of ways in which teachers can move from “big ideas” to specific lesson plan goals and activities and then return with their students to the “big ideas” of science.

Curriculum development has been successful used as a vehicle for staff development. Research is need to determine if the development of assessment systems can also be effectively used as a vehicle for staff development. Two of the teachers who participated in this study indicated an interest in continuing to work with the author to develop teacher research projects in their classrooms. They want to develop a set of multiple assessment activities and a record keeping system that will reflect where their students are in the journey toward achieving the seven science standards without burying them in mounds of paperwork.
How can we help teachers' develop a greater understanding of assessment issues and their relationship to science learning? One current issue is how to assess students' progress toward achieving the science standards and benchmarks. Using Project 2061's Assessment Analysis Framework with teachers as a basis for beginning assessment conversations may prove to be effective. It would help teachers create a vocabulary with which to evaluate their assessments and examine the content standards and benchmarks. The dialogue created between researchers and teachers can enrich our understanding of science teaching and learning in the classroom.

Finally, and perhaps most importantly, we need to continue looking for ways to bridge the gap between research and the classroom by helping teachers to identify and to try out in their classrooms what has come to be known as "best practice" for effective science teaching and learning. What we know today about how students learn is very different from what was believed 20 years ago. Unfortunately, for a variety of reasons many teachers do not expand their professional knowledge base and therefore do not have access to a very rich data base that has the potential to improve their teaching skills and professional knowledge base.
REFERENCES


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APPENDIX A

STANDARDS FOR TEACHER COMPETENCE IN EDUCATIONAL ASSESSMENT OF STUDENTS *

1. Teachers should be skilled in choosing assessment methods appropriate for instructional decisions.

2. Teachers should be skilled in developing assessment methods appropriate for instructional decisions.

3. Teachers should be skilled in administering, scoring and interpreting the results of both externally produced and teacher-produced assessment methods.

4. Teachers should be skilled in using assessment results when making decisions about individual students, planning teaching, developing curriculum, and school improvement.

5. Teachers should be skilled in developing valid pupil grading procedures that use pupil assessments.

6. Teachers should be skilled in communicating assessment results to students, parents, other lay audiences, and other educators.

7. Teachers should be skilled in recognizing unethical, illegal, and otherwise inappropriate assessment methods and uses of assessment information.

* Developed by the: American Federation of Teachers, the National Council on Measurement in Education, and the National Education Association, 1990
APPENDIX B

MAP OF LOUISIANA SCHOOL DISTRICTS

EXHIBIT 7: ECONOMIC CONDITION OF PUBLIC SCHOOL POPULATION BY DISTRICT.

Percentage of Student Body participating in the Federal Free or Reduced Lunch Program: 1997-98
- 0-25%
- 26-50%
- 51-75%
- 76-100%

Source: Student Information System (SIS), October 1, 1997 audited count.
Statewide, 59.2% of all students participated in the Free or Reduced Lunch Program during 1997-98.

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APPENDIX C

LETTER OF PERMISSION TO SUPERINTENDENTS AND FOLLOW UP LETTER

May 23, 2001

Dear "Prefix" "LastName",

The new Louisiana high stakes testing policy has created anxiety among classroom teachers and school administrators. One way to help raise test scores is to align curriculum, instruction and assessment. Available research-based literature lacks clear information regarding middle-school science teachers' classroom assessment practices and the relationship of these practices to the science content and assessment standards.

I am writing to request permission to survey a random sample of middle school science teachers in <parish>. The information from this survey will be used as one part of my dissertation study for my doctoral program in curriculum and Instruction at Louisiana State University.

Teachers will be asked to respond to questions concerning their classroom assessment practices and their use of science content and assessment standards in planning their lessons and student assessment. In addition, teachers in several other Louisiana parishes will be surveyed.

If you agree to this request I will with your permission, contact your personnel director to obtain a printed list of names of the 5th, 6th, 7th, and 8th grade science teachers at each school. It would be very helpful if at this time you would request this list. If this list is in a database, it can be sent to me on a diskette as an RTF file, any version of Microsoft Word, or Excel. My email address is kmcwaters@satjohn.k12.la.us. Please return the enclosed form to me in the self-addressed and stamped envelope.

At your request I will gladly furnish you with a copy of the completed dissertation. If you have any questions, please call me. My number is 504-336-1106. Thank you in advance for your cooperation.

Sincerely,

Kathy J. McWaters
Please fax this form to: 504-536-6461

☐ Kathy J. McWaters has my permission to survey a random sample of middle school science teachers (grades 5, 6, 7 and 8) in this parish concerning their classroom assessment practices and the relationship of these practices to the science content and assessment standards.

☐ I am sorry, but we are not going to be able to participate in this survey.

Signature of the Superintendent

______________________________________________

To obtain a list of teachers by school contact:

Personnel Director ___________________________________________

(Please print name)

School System: «Parish» Parish
May 23, 2001

Dear «Prefix» «LastName»,

Last month I wrote to you to request permission to survey a random sample of middle school science teachers in «Parish» Parish. The information from this survey will be used as one part of my dissertation study for my doctoral program in Curriculum and Instruction at Louisiana State University. Teachers will be asked to respond to questions concerning their classroom assessment practices and their use of science content and assessment standards in planning their lessons and student assessments. I am hoping that your teachers will be able to participate and represent your parish in this study.

If you agree to this request I will, with your permission contact your personnel director to obtain a printed list of names of the 5th, 6th, 7th, and 8th grade science teachers at each school. If this list is in a database it would be very helpful for you to send it to me on a diskette or email file. My email address is kmcwaters@stjohn.k12.la.us. Please fax the enclosed form to me 1-504-536-6461.

If you have any questions/concerns, please call me. My number is 504-536-1106. Thank you in advance for your cooperation.

Sincerely,

Kathy J. McWaters
Curriculum/Staff Development Coordinator
St. John Parish
I need your help. Your superintendent has granted me permission to survey a sample of middle school science teachers in your parish. Please see attached form.

I am requesting from you a list (by school and grade) of the names of the 5th, 6th, 7th, and 8th grade teachers in your parish who are employed for the school year 1999-2000 and who teach at least one science class a day. This survey is part of my research for my dissertation. Thank you so much for your cooperation – without your help I won’t be able to complete my study. My goal is to mail the surveys to the teachers in two weeks.

Please feel free to send the list to be by:
Fax: (504) 536-6461
Email: kmcwaters@stjohn.k12.la.us, or
Mail: 382 Fairway Dr. Unit 26; LaPlace, LA 70068

Again, thank you for your time and effort, both are greatly appreciated. If you have any questions or concerns, please call me 504-536-1106.
Please fax this form to: 504-536-6461

☐ Kathy J. McWaters has my permission to survey a random sample of middle school science teachers (grades 5, 6, 7 and 8) in this parish concerning their classroom assessment practices and the relationship of these practices to the science content and assessment standards.

☐ I am sorry, but we are not going to be able to participate in this survey.

____________________________________
Signature of the Superintendent

To obtain a list of teachers by school contact:

Personnel Director __________________________
(Please print name)

School System: «Parish» Parish
APPENDIX E

QUESTIONNAIRE

Classroom Assessment Practices Questionnaire

This survey is designed to identify current classroom assessment practices of middle school science teachers.

1. Rate the importance of the following factors as to how strongly each one influences your decision to select an assessment or particular type of assessment. (Mark a number from 1 to 5 for each factor, where 1 = 'not' influential and 5 = 'most important' influential.)

<table>
<thead>
<tr>
<th>Factor</th>
<th>Strong Influence</th>
<th>Medium Influence</th>
<th>Weak Influence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Purpose for assessment:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The students I am assessing:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Use of assessment information by the teacher:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Student characteristics being assessed (e.g., knowledge, skills, reasoning ability, attitude):</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Science topics being assessed:</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Opportunity for students to evaluate the knowledge claims of others:</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Opportunity for students to build connections between prior knowledge and new concepts:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The need for students to construct progressively more powerful explanations:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Time it takes for students to complete the assessment:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Time it takes for me to grade the assessment:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Confidence that the test really measures what I think it measures:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Confidence that the same student taking the test at another time will perform at about the same level:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>My understanding of how students learn:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Alignment of test content and format with national science standards:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Alignment of test content and format with state/district standards:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Alignment of test content and format with state testing:</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

2. In your undergraduate or graduate courses which types of assessment did you learn how to select, construct, and/or interpret? (Check all that apply.)

- Objective tests
- Performance assessments
- Concept Maps
- Portfolios
- Tests provided with the textbook
- Oral questioning
- Standardized tests
- Science lab practices
- Other (Please Specify)

3. In your inservice programs which types of assessment did you learn how to select, construct, and/or interpret? (Check all that apply.)

- Objective tests
- Performance assessments
- Concept Maps
- Portfolios
- Tests provided with the textbook
- Oral questioning
- Standardized tests
- Science lab practices
- Other (Please Specify)

4. How would you describe the primary resource you use to deliver science instruction to your students? (Check only one choice, you may use 'other' to write in combinations.)

- A textbook
- A computer-based module
- A combination of textbook and activity-based modules
- A technology-based science program (e.g., Windows on Science)
- Other (Please Specify)
5. Different assessment formats provide different kinds of information used for different purposes. For each assessment format listed below, please darken the assessment format that you use in your classroom.

<table>
<thead>
<tr>
<th>Assessment Format</th>
<th>I Usually Use</th>
<th>2 Sometimes Use</th>
<th>3 Occasionally Use</th>
<th>4 Rarely Use</th>
<th>5 Never Use</th>
<th>Code (0-5)</th>
</tr>
</thead>
<tbody>
<tr>
<td>When diagnosing the strengths and weaknesses of individual students, I usually use.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>When diagnosing group needs, I usually use.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>When evaluating an instructional unit to see if it worked, I usually use.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>When you want to assess students' ability to use science knowledge and understanding in order to review, an assessment leads to the ability to solve problems, I usually use.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>When determining student progress toward performance goals, I usually use.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>When determining student progress toward instruction goals, I usually use.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>When I want to assess students' skills in science, where it is the process of doing something that is important, I usually use.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>When I want to assess students' ability to use science skills to create tangible products, which provide concrete evidence of proficiency, I usually use.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>When assessing students' mastery of science knowledge, where mastery includes both knowledge and understanding, I usually use.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>When I want to assess students' attendance, interests, etc., I usually use.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0</td>
</tr>
</tbody>
</table>

6. What kinds of materials do you most frequently use to enrich your science instruction? (Please, darken only one choice, you may use "other" to write in combinations)

- Ready-to-use
- Manipulatives
- Lab equipment
- Electronic media
- Video cassette
- Textbook
- Computer programs
- Teacher's guide
- Model
- Other (Please Specify)

7. Rate the contribution of the following sources as to how they contributed to your knowledge of selecting, developing, and interpreting classroom assessments. (Place a number from 1 to 6 for each source of information, where 6 is most helpful and 1 is least helpful)

- Undergraduate testing/assessment course
- Graduate methods course
- Graduate testing/assessment course
- Experience as a classroom teacher
- Experience as a student
- LSAT course
- LSAT workshop
- Dissertation training (other than LSAT)
- Professional conferences/conventions (e.g., NSTA, NCTM, NCTQ)
- Other (write in)

---

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9. Briefly provide an example of how you use the science standards when planning for instruction.

10. Briefly provide an example of how you use the science standards when constructing or selecting assessments.

11. About how often do you do each of the following in your science instruction?

   a. Introduce content through formal presentations
   b. Demonstrate a science-related concept or principle
   c. Engage students to facilitate student discussion
   d. Use open-ended questions
   e. Require students to supply evidence to support their claims
   f. Encourage students to explain concepts to one another
   g. Require students to consider alternative explanations
   h. Let curriculum demands prevent you from allowing students to work at their own pace
   i. Help students see connections between science and other disciplines
   j. Use assessment to find out what students know before or during a unit
   k. Regularly assess performance of students using the standards
   l. Use the standards as a resource

   [Blank spaces for frequency ratings: daily, weekly, monthly, less than monthly, never, not applicable]
12. Some people have suggested that new students develop their own ideas to explain nature, and sometimes their explanations can be substantially different from the scientific theories. What do you think about this suggestion?

13. Briefly describe your own explanation about how learning occurs.

14. Briefly explain the teacher's role in promoting learning.

15. About how often do students in your class take part in each of the following types of activities as part of their science instruction?

<table>
<thead>
<tr>
<th>Activity Description</th>
<th>Never</th>
<th>Once a Term</th>
<th>More than Once a Term</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Participate in student-led discussions</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>b. Make formal presentations in class</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>c. Use other (non-textbook) science-related materials in class</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>d. Answer textbook/worksheet questions</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>e. Work on solving a real-world problem</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>f. Engage in hands-on science activities</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>g. Work on models or simulations</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>h. Complete work in a laboratory</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>i. Complete homework or projects</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>j. Take part in a team project</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>k. Take part in multiple choice tests</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>l. Take part in a simulation</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>m. Participate in a middle school science fair</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>n. Participate in a science bee</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>o. Participate in a science competition</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>p. Participate in a science fair</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>q. Participate in a science fair</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>r. Participate in a science fair</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>s. Participate in a science fair</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>t. Participate in a science fair</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
16. Briefly explain the student’s role in promoting learning.

17. Are you a certified teacher?
   ○ Yes ○ No

18. How many years of teaching experience do you have?
   ○ 0 - 1
   ○ 2 - 5
   ○ 6 - 10
   ○ 11 - 20
   ○ 21 - 30
   ○ 31 - 40
   ○ 41 - 50
   ○ 51 - 60
   ○ 61 - 70
   ○ 71 - 80
   ○ 81 - 90
   ○ 91 - 100
   ○ 101 - 120
   ○ 121 - 140
   ○ 141 - 160
   ○ 161 - 180
   ○ 181 - 200
   ○ 201 - 220
   ○ 221 - 240
   ○ 241 - 260
   ○ 261 - 280
   ○ 281 - 300
   ○ 301 - 320
   ○ 321 - 340
   ○ 341 - 360
   ○ 361 - 380
   ○ 381 - 400
   ○ 401 - 420
   ○ 421 - 440
   ○ 441 - 460
   ○ 461 - 480
   ○ 481 - 500
   ○ 501 - 520
   ○ 521 - 540
   ○ 541 - 560
   ○ 561 - 580
   ○ 581 - 600
   ○ 601 - 620
   ○ 621 - 640
   ○ 641 - 660
   ○ 661 - 680
   ○ 681 - 700
   ○ 701 - 720
   ○ 721 - 740
   ○ 741 - 760
   ○ 761 - 780
   ○ 781 - 800
   ○ 801 - 820
   ○ 821 - 840
   ○ 841 - 860
   ○ 861 - 880
   ○ 881 - 900
   ○ 901 - 920
   ○ 921 - 940
   ○ 941 - 960
   ○ 961 - 980
   ○ 981 - 1000
   ○ 1001 - 1200
   ○ 1201 - 1400
   ○ 1401 - 1600
   ○ 1601 - 1800
   ○ 1801 - 2000
   ○ 2001 - 2200
   ○ 2201 - 2400
   ○ 2401 - 2600
   ○ 2601 - 2800
   ○ 2801 - 3000
   ○ 3001 - 3200
   ○ 3201 - 3400
   ○ 3401 - 3600
   ○ 3601 - 3800
   ○ 3801 - 4000
   ○ 4001 - 4200
   ○ 4201 - 4400
   ○ 4401 - 4600
   ○ 4601 - 4800
   ○ 4801 - 5000
   ○ 5001 - 5200
   ○ 5201 - 5400
   ○ 5401 - 5600
   ○ 5601 - 5800
   ○ 5801 - 6000
   ○ 6001 - 6200
   ○ 6201 - 6400
   ○ 6401 - 6600
   ○ 6601 - 6800
   ○ 6801 - 7000
   ○ 7001 - 7200
   ○ 7201 - 7400
   ○ 7401 - 7600
   ○ 7601 - 7800
   ○ 7801 - 8000
   ○ 8001 - 8200
   ○ 8201 - 8400
   ○ 8401 - 8600
   ○ 8601 - 8800
   ○ 8801 - 9000
   ○ 9001 - 9200
   ○ 9201 - 9400
   ○ 9401 - 9600
   ○ 9601 - 9800
   ○ 9801 - 10000
   ○ 10001 - 12500

19. How many years have you taught science?
   ○ 0 - 2
   ○ 3 - 5
   ○ 6 - 10
   ○ 11 - 15
   ○ 16 - 20
   ○ 21 - 25
   ○ 26 - 30
   ○ 31 - 35
   ○ 36 - 40
   ○ 41 - 45
   ○ 46 - 50
   ○ 51 - 55
   ○ 56 - 60
   ○ 61 - 65
   ○ 66 - 70
   ○ 71 - 75
   ○ 76 - 80
   ○ 81 - 85
   ○ 86 - 90
   ○ 91 - 95
   ○ 96 - 100
   ○ 101 - 125

20. Gender
   ○ Male ○ Female

21. What grade(s) do you currently teach science? (Mark as many that apply)
   ○ Kindergarten
   ○ Elementary
   ○ Middle School
   ○ High School
   ○ Other

22. This year my class situation is
   ○ Self-contained
   ○ Departmentalized
   ○ Team taught
   ○ Block schedule
   ○ Other

23. The average class size at my school is
   ○ 15 or less
   ○ 16 - 20
   ○ 21 - 25
   ○ 26 - 30
   ○ 31 - 35
   ○ 36 - 40
   ○ 41 - 45
   ○ 46 - 50
   ○ 51 - 55
   ○ 56 - 60
   ○ 61 - 65
   ○ 66 - 70
   ○ 71 - 75
   ○ 76 - 80
   ○ 81 - 85
   ○ 86 - 90
   ○ 91 - 95
   ○ 96 - 100
   ○ 101 - 120
   ○ 121 - 140
   ○ 141 - 160
   ○ 161 - 180
   ○ 181 - 200
   ○ 201 - 220
   ○ 221 - 240
   ○ 241 - 260
   ○ 261 - 280
   ○ 281 - 300
   ○ 301 - 320
   ○ 321 - 340
   ○ 341 - 360
   ○ 361 - 380
   ○ 381 - 400
   ○ 401 - 420
   ○ 421 - 440
   ○ 441 - 460
   ○ 461 - 480
   ○ 481 - 500
   ○ 501 - 520
   ○ 521 - 540
   ○ 541 - 560
   ○ 561 - 580
   ○ 581 - 600
   ○ 601 - 620
   ○ 621 - 640
   ○ 641 - 660
   ○ 661 - 680
   ○ 681 - 700
   ○ 701 - 720
   ○ 721 - 740
   ○ 741 - 760
   ○ 761 - 780
   ○ 781 - 800
   ○ 801 - 820
   ○ 821 - 840
   ○ 841 - 860
   ○ 861 - 880
   ○ 881 - 900
   ○ 901 - 920
   ○ 921 - 940
   ○ 941 - 960
   ○ 961 - 980
   ○ 981 - 1000
   ○ 1001 - 1250

24. My school’s population is
   ○ Less than 100
   ○ 101 - 200
   ○ 201 - 300
   ○ 301 - 400
   ○ 401 - 500
   ○ 501 - 600
   ○ 601 - 700
   ○ 701 - 800
   ○ 801 - 900
   ○ 901 - 1000
   ○ 1001 - 1200
   ○ 1201 - 1500
   ○ 1501 - 2000
   ○ More than 2000

25. My school is located in an area that is classified as
   ○ Rural
   ○ Urban or small city
   ○ Suburban
   ○ Other

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DATE

NAME

ADDRESS

CITY, STATE, ZIP

Dear

The new Louisiana high stakes testing policy has created anxiety among classroom teachers. Many are concerned about how to raise test scores. One way to help raise test scores is to align curriculum, instruction and classroom assessment; however, little information is available to help us understand how teachers across our state are achieving this alignment.

Because alignment is a complex process, this survey will focus on the part of the process related to classroom assessment, instruction and the science standards. As a fellow teacher I am interested in both your opinions and classroom practices. The results from this survey will be used as one part of my dissertation study for my doctoral program in Curriculum and Instruction at Louisiana State University.

Your name was randomly chosen from a list of middle school teachers in your school district who are currently teaching at least one science class to 5th, 6th, 7th, and/or 8th grade students. Please take a few minutes and fill out the questionnaire. Your individual answers will be held in the strictest of confidence and only the totals will be reported.

Each questionnaire is numbered so that I can send out reminders to teachers who forget to return the questionnaire. Once the questionnaires are returned, all codes will be destroyed so that no one teacher can be associated with answers to the questions. Once you have completed the questionnaire place it in the enclosed self addressed, stamped envelope and drop it in the mail.

If you have any questions, please call me. My number at work is 504-536-1106 and at home is 504-651-4206. Thank you in advance for your cooperation.

Sincerely,

Kathy J. McWaters
St. John the Baptist Parish
Dear

The new Louisiana high stakes testing policy has created anxiety among classroom teachers. Many are concerned about how to raise test scores. One way to help raise test scores is to align curriculum, instruction and classroom assessment; however, little information is available to help us understand how teachers across our state are achieving this alignment.

Because alignment is a complex process, this survey will focus on the part of the process related to classroom assessment, instruction and the science standards. As a fellow teacher I am interested in both your opinions and classroom practices. The results from this survey will be used as one part of my dissertation study for my doctoral program in Curriculum and Instruction at Louisiana State University.

All middle school teachers in St. John who are currently teaching at least one science class to 5th, 6th, 7th, and/or 8th grade students are being asked to take a few minutes and fill out this questionnaire. Your individual answers will be held in the strictest of confidence and only the totals will be reported.

Each questionnaire is numbered so that I can send out reminders to teachers who forget to return the questionnaire. Once the questionnaires are returned, all codes will be destroyed so that no one teacher can be associated with answers to the questions. Once you have completed the questionnaire place it in the enclosed envelope and drop it in the school mail that is sent to the central office or call me and I will personally pick it up.

This questionnaire has been sent to hundreds of teachers in the state of Louisiana. In addition, I would like to include classroom observations in my study. If you are interested in learning more about science assessment by continuing to participate in this study, please sign the bottom of this letter and return it with the questionnaire and I will call you and schedule a time for us to meet. At that time, you can decide if you are definitely interested.

If you have any questions, please call me. My number at work is 504-536-1106 and at home is 504-651-4206. Thank you in advance for your cooperation.

Sincerely,

Kathy J. McWaters

You may contact me at home __________________
I prefer to be contacted at school __________________

Signed __________________

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APPENDIX G

CONSENT FORM

Project Title:
An Exploratory Study of the Influence of National and State Standards on Middle School Science Teachers' Classroom Assessment Practices

This consent form provides detailed information about the research study in which you have been asked to participate. You may decline to participate (participation is completely voluntary) or withdraw from this study at any time.

Purpose of Study and Selection of Subjects

1. You are invited to participate in a research study that will identify the current classroom assessment practices of selected middle school (grades 5, 6, 7 and 8) science teachers.
2. This researcher hopes to gain an understanding of how teachers measure students' science learning in the classroom and to explore the relationship between teachers' classroom assessment practices and those suggested by science reform documents.
3. Because you are employed to teach at least one class of science for the 1999-2000 school year you may volunteer to participate. From the pool of volunteers, 2 teachers at each middle school grade level will be included in this study.
4. If you choose to participate, you may gain increased understanding of your own classroom assessment practices and how they inform student learning.
5. You will be asked to participate in interviews, allow this researcher to make classroom observations, and share your lesson plans and assessment documents during a science teaching episode of your choosing. The episode must be no longer than two weeks and taught between January and May, 2000. Interviews and observations will be scheduled to accommodate your schedule and the researcher's. During the interviews your responses will be audiotaped.
6. In an effort to maintain confidentiality, I will use pseudonyms for each teacher in the study and mask the names of the schools. The pseudonyms will be used in all notes, journals, and transcriptions so even an outside reader of the rough transcripts will be unaware of the participants' identities.
7. Questions should be directed to Kathy McWaters, phone: 651-4206 or 536-1106.

I have been fully informed of the above-described procedure with its possible benefits and risks and I give my permission for participation in the study.

_________________________________________  __________________________
Participant’s Signature                             Date

_________________________________________  __________________________
Signature of Principle Investigator               Date

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APPENDIX H

PROJECT 2061'S ASSESSMENT ANALYSIS

Preliminary Evaluation

The analysis begins with an item or test that appears promising – the content doesn’t appear too far outside the scope of science literacy and it contains at least some open-response opportunities. The task is to identify a collection of specific learning goals (benchmarks or standards) that appear to be central to the item or test.

First, reviewers search fairly quickly through the item or test (both questions and scoring guides or rubrics) to make a preliminary list of all the specific learning goals that would seem likely to be targeted. The assessment is then examined more carefully to determine whether each learning goal is actually seen — e.g., particular items, questions, and performances. Then, based on the analysis, benchmarks and standards are ranked from high to low to give a rough picture of how well they are addressed in the item or test.

Content Alignment

This analysis is a more rigorous examination of the link between the assessment and the selected learning goals. It proceeds in one or two stages, depending on the length of the assessment.

If the analysis is of a single item, possibly with a few sub questions, the content analysis consists of an intense investigation of the match between one or two key benchmarks and the item. The first step involves giving precise attention to both ends of the match in order to clarify the specific ideas and skills that are included in the benchmarks of interest and to identify which of those ideas and skills receive significant attention in the assessment under study. Answers are sought to such questions as:

Substance

Does the item address the specific substance of a benchmark or is there only a general “topic” correspondence? Does the item address specific content knowledge or does it mainly require only general knowledge? Does the item require additional specialized knowledge not included in the benchmark?
**Sophistication**

Does the item reflect the level of sophistication of the benchmark or is it more appropriate for assessing benchmarks at an earlier or later grade level?

**Part/Whole**

Does the item address all elements of a benchmark, or only some parts? If the latter, what is the consequence?

If the analysis is of an entire assessment, a subtest that consists of several items, or a long multi-step item that addresses several benchmarks, the first step is followed by a second one, which surveys the assessment as a whole. The purpose of surveying the test as a whole is to estimate the degree of overlap between its content and the learning goals of interest. This analysis addresses questions such as these:

**Coverage**

What set of benchmarks for a given topic and grade level are addressed by the test? Which, if any, are not treated? Are the missing benchmarks essential?

**Extraneous Content**

Does the test contain content—knowledge and skills—not required for reaching science literacy learning goals? If so, in what proportion?

**Format Analysis**

The purpose of the format analysis is to estimate how well the item addresses the central benchmarks from the perspective of what is known about student learning and effective assessment. The criteria for making such judgments are derived from research on assessment and from experience in classrooms and testing.

Four criteria have been identified to serve as a basis for the format analysis. Stated as questions, these are:

**Fit of Item Format**

Does the question (open-response, multiple choice, etc.) fit the type of knowledge assessed (e.g., skill, knowledge, application)? Does the type of question provide an opportunity to determine whether or not a student has actually met the relevant learning goal?

**Important Ideas**

Are the scientific or mathematical ideas important, and are they given more attention in the item than reading skills, or recall of technical terms, vocabulary, or symbols? Does the item address central ideas rather than isolated pieces of information? Does the item...
require students to apply big ideas explaining phenomenon, or in making inferences or deductions?

**Context and Fairness**

Does the item use a familiar, realistic, or meaningful setting that is relevant to the targeted benchmark? Does the item help students see that the question or problem is important to address? Does the item use a context or situation that is familiar to all backgrounds and to both genders? Is the language clear and readable?

**Usefulness**

Does the item or scoring rubric provide information that would be useful to the student, teacher, or others in finding out about progress toward the learning goal or how to improve future instruction?

**Profile**

Having completed both a content analysis and a format analysis, the final step in the process is to prepare a profile that summarizes the main features of the subject material. Such a profile will include the conclusions reached with regard to 1) the treatment of key benchmarks, and 2) the over-all character of the material. Even though the profile includes judgments regarding how well individual learning goals are treated, points to various strengths and weaknesses in the subject material, it does not conclude with a final, over-all rating.

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SECTION I: (1 pt each) Complete the sentences using the words below. Write the correct word in the blank and place the letter in front of it in the blank in front of the sentence.

a. thermal energy  

b. conductor  
c. absolute zero  
d. radiation  
e. thermometer  
f. evaporation  
g. heat  
h. temperature  
i. energy  
j. condensation  
k. insulator  
l. convection  
m. degrees

1. The movement of thermal energy is _______________.

2. The temperature at which all motion of molecules would stop is _________________.

3. ________________ is the ability to do work.

4. The average kinetic energy of the molecules of a substance is its _________________.

5. A substance through which thermal energy flows rapidly is called a(n) _________________.

6. ________________ is the process by which energy is transferred by means of electromagnetic waves.

7. A(n) ________________ measures temperature by using a substance that expands and contracts.

8. When a gas changes to a liquid, the process is called _________________.

9. Temperature is measured in _________________.

10. A substance through which thermal energy flows very slowly _________________.

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SECTION II: (1 pt each) Write the letter of the correct answer in the blank.

11. By rubbing your hands together when they are cold, you_________.
   a. use mechanical energy to decrease their thermal energy
   b. convert mechanical energy into thermal energy
   c. use thermal energy to increase their potential energy
   d. leave their energy unchanged

12. The freezing point of water is _______ the melting point of ice.
   a. greater than
   b. lower than
   c. the same
   d. none of the above

13. Convection can occur _______.
   a. in solids, liquids, gases
   b. in solids and liquids
   c. in liquids and gases
   d. only in liquids

14. Which one is the poorest conductor?
   a. copper
   b. stainless steel
   c. iron
   d. plastic

15. On the Celsius scale, the difference between the boiling point and the freezing point of water is _______.
   a. 10 degrees
   b. 32 degrees
   c. 100 degrees
   d. 273 degrees

16. When a solid turns liquid, its particles _______.
   a. gain kinetic energy
   b. move slower
   c. evaporate
   d. lose energy

17. According to the law of conservation, energy cannot be _______.
   a. transferred or changed
   b. transferred or destroyed
   c. created or destroyed
   d. created & transferred
18. The movement of electrons along a wire creates friction and releases _______.
   a. hydropower
   b. evaporation
   c. thermal energy
   d. light

19. When you measure the temperature of an object, you are measuring the _______.
   a. average kinetic energy of its particles
   b. average potential energy of its particles
   c. total thermal energy of the object
   d. potential energy of the whole object

20. A person cannot survive very long if an accident throws him into cold water because ________.
   a. body heat rises
   b. water is a poor conductor
   c. body heat is transferred to the water
   d. water temperature is lower than air temperature

21. Weather patterns and movement of the air are, in part, the result of heat transfer by _______.
   a. insulation
   b. convection
   c. air spaces
   d. conduction

SECTION III: (5 pts each) Answer the following question on loose leaf paper.

22. Use what you have learned to explain what happens when a pot of water is heated on a stove. Include as many details and science vocabulary words as possible.

23. Why isn't it a good idea for your stove to be next to your refrigerator?

24. Explain how conduction, convection and radiation have a part in creating our weather.

25. What does a thermometer measure - kinetic energy or thermal energy? Explain your answer.
26. In your take home activity explain
   1. what you used to insulate your box
   2. why you chose that insulation
   3. what were your results
   4. explain what you think happened inside your box
   (use as many science words as you can)

Section IV: (25 points) Performance Assessment

Read the following two pages. Wait for your teacher to call you.
when your name is called you will take the last two pages into the lab
and complete numbers 1 and 2 then return to your desk in the classroom
to complete numbers 3 and 4.

**Energy Activity**

You are trying to invent a new manufacturing process. As part of this process,
however, 10,000 kiloliters of very hot water will be mixed with 20,000 kiloliters of
cold water, and before you can build the equipment, you need to know what the
temperature of the mixture of hot and cold water will be.

Obviously, it's not practical actually to mix 10,000 kiloliters of hot water and 20,000
kiloliters of cold water together to see what the resulting temperature will be. So,
you will need to base your answer on a model.

You have been given three large containers labeled **hot water**, **cold water**, and **waste
water**. You also have two cups labeled **measuring cup** and **mixing cup**. You have a
thermometer for measuring temperature, a spoon for stirring, and paper towels for
wiping up any spills.

• On your data sheet write down the steps of your model experiment.
• Now conduct the experiment you have outlined.
• In the space provided, explain why the temperature of the mixture of the hot and cold water came
out as it did. Use the terms **thermal energy**, **temperatures**, **kinetic energy**, and **molecules** in your answer.
• Use what you learned from your model to predict the temperature of the mixture of hot and cold
water given in the last question.

When you have finished—
• Empty the water from the mixing cup into the waste water container.
• Wipe up any spills.
• Leave the rest of the materials as you found them.

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Data Sheet for Performance Assessment

1. List the steps of your model experiment.

2. Enter the temperatures of the water.

<table>
<thead>
<tr>
<th>Water Type</th>
<th>Volume of Water (in terms of cups)</th>
<th>Temperature</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cold Water</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Hot Water</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Water Mixture</td>
<td>3</td>
<td></td>
</tr>
</tbody>
</table>

3. Explain your results, using the terms thermal energy, temperature, kinetic energy, and molecules in your answer.

4. If you mixed 10,000 kiloliters of 95°C water with 20,000 kiloliters of 5°C water, what would the temperature of the resulting mixture be—5°C, 55°C, 65°C, or 95°C? Assume that the temperature of the surroundings has no effect in this case. Explain your answer.
Directions:
Choose a cartoon. Explain how the cartoon relates to the earth science or earth history topic listed above the cartoon.

1. Earth Time Line or dinosaurs

NON SEQUITUR

OOGOOGL! I CAN SEE THAT THE FUTURE HOLDS AN IMPORTANT ROLE FOR YOU IN THE OIL INDUSTRY

Volcanoes or Plate Tectonics

THANK YOU FOR NOT EXODING

Rock Cycle or Earth Time Line? Explain:

IS THE SOUP FRESH?

RELATIVELY, AT A GUESS, I'D SAY ABOUT 125 MILLION YEARS OLD.

Pavlov
7th SCIENCE  4th 9 WEEKS
DINO PROJECT
PRESENTATION
EVALUATION

NAME:
CLASS:
DATE:

paleontologist's construction  10
assembly  10
authentication (color, design, pose
position, research )  20
prediction (dinosaur with hide)  20
environment (food source, appropriate
era, period and geologic occurrences)  20
Name  10
Oral presentation (enthusiasm, accuracy,
efficiency, knowledge of subject)  10
TOTAL EARNED
TOTAL POSSIBLE  100

COMMENT:
WHAT'S THE NATURE OF EARTH'S ATMOSPHERE?

Name_____________________

PART A Match the definitions on the left with the terms on the right. (There are more terms than there are definitions.)

1. Mixture of gases that make up the atmosphere
   a. air
   b. atmosphere

2. Energy absorbed equals energy radiated
   d. radiation balance
   e. solar radiation

3. Energy from the sun
   f. oxygen

4. Vast ocean of air that surrounds Earth

PART B Write the letter of the correct answer in the blank.

5. Earth's atmosphere is warmed by ____________
   a. Earth's inner core
   b. energy from the sun
   c. the moon
   d. tropical ocean breezes

6. Energy from the sun is reflected by ____________
   a. clouds
   b. Earth's surface
   c. oceans
   d. all of the above

7. Earth as a whole ____________
   a. loses more energy than it gains
   b. gains more energy than it loses
   c. gains and loses the same amount of energy
   d. none of the above

8. Air contains ____________
   a. gases
   b. water
   c. dust particles
   d. all of the above

9. The gas that makes up most of the air is ____________
   a. nitrogen
   b. oxygen
   c. carbon dioxide
   d. hydrogen

10. The gas in the atmosphere that is continually being renewed by plants is ____________
    a. nitrogen
    b. oxygen
    c. hydrogen
    d. ammonia

PART C Match the layers of the atmosphere listed on the left with the diagram on the right.

11. stratosphere
12. mesosphere
13. troposphere
PART 1 - MATCHING: Match the vocabulary words in Column A to the correct definition in Column B.

<table>
<thead>
<tr>
<th>Column A</th>
<th>Column B</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. trace fossils</td>
<td>A. A fossil formed when minerals fill a fossil mold.</td>
</tr>
<tr>
<td>2. cast</td>
<td>B. A rock or mineral in Earth containing enough of a metal or useful mineral to make mining profitable.</td>
</tr>
<tr>
<td>3. molds</td>
<td>C. Fossils of the evidence of once living organisms; includes tracks and burrows.</td>
</tr>
<tr>
<td>4. ores</td>
<td>D. A cavity or impression left by an organism in sediment.</td>
</tr>
</tbody>
</table>

PART 2 - MATCHING: Match the vocabulary words in Column A to the correct definition in Column B.

<table>
<thead>
<tr>
<th>Column A</th>
<th>Column B</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. igneous rock</td>
<td>A. Parallel layers of material, such as rock or soil; especially, several layers of sedimentary rock lying one on top of the other.</td>
</tr>
<tr>
<td>2. granite</td>
<td>B. Rock formed from molten Earth material.</td>
</tr>
<tr>
<td>3. basalt</td>
<td>C. A dark igneous rock formed at Earth's surface that makes up Earth's crust under the ocean.</td>
</tr>
<tr>
<td>4. strata</td>
<td>D. A light-colored igneous rock formed beneath Earth's surface that makes up most of Earth's continents.</td>
</tr>
</tbody>
</table>
PART 3 - FILL IN THE BLANK: Choose the correct word from the word bank. You WILL NOT use all of the words given.

1. Earth’s crust is made largely of __________________________.
2. Earth’s time capsule is in its __________________________.
3. In rock layers, the youngest fossils are found on the __________________________ layers.
4. The hardest minerals on Earth are __________________________.
5. __________________________ is made when oxygen combines with iron.
6. In rock layers, the oldest fossils are found on the __________________________ layers.

PART 4 - MULTIPLE CHOICE: Fill in the circle for the correct answer.

1. The Proterozoic period began when Earth first
2. When matter is left alone, it
   O disappears.  O stays the same.  O changes form.
3. The first continent began to appear about
   O 2.5 billion years ago.  O 4.3 billion years ago.  O 2 billion years ago.
4. Old rocks and fossils are sometimes exposed due to
5. Concrete clues about organisms that have lived on Earth can be found in
6. Fossils can be found almost anywhere there is
PART 5 - TRUE/FALSE: Write TRUE or FALSE in the blank.

_____ 1. To learn more about our planet we need to know where, when and how to look for clues.

_____ 2. We know so little about Precambrian life because Precambrian fossils are easily found.

_____ 3. Paleontologists use their studies of fossils to draw conclusions about what Earth will be like in future years.

_____ 4. Extinctions are indicated by the disappearance of organisms from the fossil record.

_____ 5. Precambrian layers are the easiest to uncover.

PART 6 - LISTING

1. List the 2 examples of igneous rock from your textbook.
   1. ______________________
   2. ______________________

2. List 3 examples of minerals from your textbook.
   1. ______________________
   2. ______________________
   3. ______________________

3. List the 3 things rocks have done throughout geological time.
   1. ______________________
   2. ______________________
   3. ______________________

BONUS: List the remaining 3 examples of minerals from your textbook. (2 points each)
Name: ________________________________

Science 9 weeks exam _______ 4th

1. River
   A. any body of fresh water flowing by gravity from upland sources to a large lake or to the sea.
   B. any body of salt water flowing by fish from a downland source to a small lake
   C. any body of water that does not flow

   A. All flow into the Mississippi
   B. All are rivers in the United States
   C. All of the above

3. New Orleans is about ______ ft below Sea Level
   A. 2 B. 4 C. 6 D. 8

4. Bayou
   A. are lakes
   B. off shoots of rivers
   C. off shoots of gold mines
5. Brackish
A. Contains a mixture of salt and fresh water
B. Lake Pontchartrain
C. All of the above

6. Watershed
A. describes an area of land that contains a common set of streams and rivers
B. Place where we keep our drinking water
C. All of the above

7. The _______ lake in Louisiana is Lake Pontchartrain.
   A. The largest
   B. The smallest
   C. All of the above

8. Canals, rivers, streams, bayous, lake and ditches all flow into
   A. Boat sheds
   B. Watershed
   C. Potting sheds
9. Endangered Species

A. Animals identified as being at risk of extinction
B. Are species native to some other part of the world
C. Are those species likely in the near future to become endangered

10. Introduced Species

A. Animals identified as being at risk of extinction
B. Are species native to some other part of the world
C. Are those species likely in the near future to become endangered

11. Threatened Species

A. Animals identified as being at risk of extinction
B. Are species native to some other part of the world
C. Are those species likely in the near future to become endangered

12. What causes the Mississippi River to flow:

A. Fish  B. Gravity  C. Rain  D. Boats
13. Nutra is an example of
   A. Endangered species
   B. Introduced species
   C. Threatened species

14. Fire ants are an example of
   A. Endangered species
   B. Introduced species
   C. Threatened species

15. Bald Eagles are
   A. Endangered
   B. Introduced
   C. Threatened

16. Aquatic
   A. Having to do with the sky
   B. Having to do with the wind
   C. Having to do with water
   D. Having to do with everything

17. Tides in Lake Pontchartrain are produced by
   A. Water
   B. Winds
   C. Weight
   D. Waves

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18. bog
A. dry land
B. wetland where the soil is soggy
C. flooded water

19. List two reasons why wetlands are important:

20. Why do people use a common classification system?

Bonus
Why do American Bald Eagles make their nest in the tops of dead trees?
PART A Complete each sentence using the best term below.

circulatory system  respiratory system  lymph nodes
red blood cells  white blood cells  antibodies

1. Small structures that filter germs in the body are ___________________.

2. Oxygen, carbon dioxide, and nutrients are carried to all parts of the body by the ___________________.

3. Proteins in the blood that fight specific diseases are ___________________.

4. The ___________________ makes oxygen available to your blood and removes carbon dioxide from your body.

PART B Write the letter of the correct answer in the blank.

5. Which large blood vessels carry blood away from the heart?
   a. veins  b. capillaries  c. arteries

6. If you get a cut, which part of the blood will help stop the bleeding?
   a. plasma  b. white blood cells  c. platelets

7. Some diseases have almost disappeared due to the use of ______
   a. fever  b. vaccines  c. white blood cells

PART C Answer the questions in the space provided.

8. List two ways germs might enter your body and ways to keep them out.

   ____________________________________________________________

   ____________________________________________________________

   ____________________________________________________________

9. What can you do to help keep your circulatory system healthy?

   ____________________________________________________________

   ____________________________________________________________


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Use the following terms or phrases to complete the concept map.

- carbon dioxide
- oxygen
- respiratory system
- lymphatic system
- nutrients
- wastes
- circulatory system
- transports
- provides protection against
- provides
- gets rid of
- oxygen
- germs

Your Body

Name: 
Date: 

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Science Test

Directions: choose the best answer to each question. Place the answer on the answer sheet.

1) ______ system is responsible for Supporting muscles.
   A) Skeletal System
   B) Muscular System
   C) Circulatory System
   D) Immune System
   F) Not here

2) ______ is a skeleton that is inside the body
   A) Skeleton System
   B) Hard Skeleton
   C) Endoskeleton
   D) Exoskeleton
   F) Not here

3) Axial Skeleton has ______ number of bones.
   A) 126
   B) 80
   C) 70
   D) 67
   F) Not here

4) Appendicular System is related to which set of bones.
   A) Ribs
   B) Cranium
   C) Spine
   D) Arms
   F) Not here

5) ______ is part of the skeletal system
   A) Muscles
   B) Joints
   C) hair
   D) nails
   F) Not here

6) What is the most important job that Red Bone Marrow makes.
   A) Fiber
   B) White Blood Cells
   C) Red Blood Cells
   D) Fat Cells
   F) Not here
7) Extra Fat Cells are located in the ________ Marrow
   A) Bone
   B) Red
   C) Yellow
   D) Gray
   F) Not here

8) ___________ is made of connective Tissue
   A) joints
   B) Red marrow
   C) Bones
   D) Cartilage
   F) Not here

9) Skeletal Muscles are attached to the __________.
   A) Skeleton
   B) Muscles
   C) feet
   D) head
   F) Not here

10) Smooth Muscles make up the __________ part of the body
    A) Stomach
    B) Arms
    C) neck
    D) electrical system
    F) Not here

11) __________ Muscles make up most of the heart.
    A) Skeletal Muscles
    B) Muscular
    C) Smooth Muscles
    D) Cardiac Muscles
    F) Not here

12) What part(s) do Muscles need to move?
    A) Flexures
    B) Extenders
    C) Joints
    D) Legs
    F) Not here
13) ____________ distributes oxygen, Hormones, and Nutrients.
   A) Circulatory System  
   B) Skeletal System 
   C) Respiratory System 
   D) Immune System 
   F) Not here

14) ____________ side of the heart pumps blood to the lungs
   A) right 
   B) left 
   C) left and right 
   D) lungs 
   F) Not here

15) ____________ is a sac that protects the heart and its neighbors.
   A) Pericardium 
   B) Septum 
   C) Cardiac Muscle 
   D) Connective Tissue 
   F) Not here

16) Arteries pump the blood _________ from the heart
    A) towards 
    B) away 
    C) small 
    D) large 
    F) Not here

17) The Veins are what size.
    A) Large 
    B) small 
    C) medium 
    D) extra large 
    F) Not here
18) ______ moves blood throughout the body
   A) Skeletal System 
   B) Muscular System 
   C) Circulatory System 
   D) All of the above 
   F) Not here 

19) ______ gives the body protection
   A) Skeletal System 
   B) Muscular System 
   C) Circulatory System 
   D) All of the above 
   F) Not here 

20) ______ is necessary for the body to move
   A) Skeletal System 
   B) Muscular System 
   C) Circulatory System 
   D) All of the above 
   F) Not here 

21) ______ moves hormones through the body.
   A) Skeletal System 
   B) Muscular System 
   C) Circulatory System 
   D) All of the above 
   F) Not here 

22) Compact Bone
23) Spongy Bone
24) Periosteum
25) Marrow
1. _______ nodules, resources of the ocean floor, are used to make steel.
   a. Coal  b. Copper  c. Lead  d. Manganese

2. The first step in strip mine land reclamation is _______
   a. covering the mined areas with soil  
   b. covering the mined areas with concrete
   c. planting new grass and trees  
   d. setting aside topsoil when mining begins

3. The gangue or waste rock is removed from metallic ore by _______
   a. crushing  b. warming  c. melting  d. washing

4. Metals are useful because they _______
   a. are inexpensive to mine  
   b. conduct electricity and are malleable
   c. are easy to mine  
   d. are in great abundance

5. Acid mine water comes primarily from the interaction of water and the sulfur containing the mineral _______.
   a. sulfite  b. pyrite  c. magnetite  d. stalactite

6. _______ is not chemically active and is used in dentistry and medicine.
   a. Gold  b. Lead  c. Halite  d. Talc

7. Limestone, clay, sulfur, potash, and mica are examples of important _______.
   a. gases  b. nonmetals  c. metals  d. minerals

8. The original source of all Earth's minerals is _______.
   a. mines  b. rivers  c. magma  d. rocks

9. Minerals mined from Earth are considered _______.
   a. nonrenewable resources  
   b. rocks  c. metals  d. plastics

10. For a mineral to be mined at a profit, it must be _______.
    a. malleable  
    b. colorful  c. in demand  d. conductive

11. An important source for most copper and gold is (s) _______.
    a. high-temperature vein deposit  
    b. contact metamorphic deposit
    c. igneous ore deposit  d. deposit from solution

12. In _______, the topsoil is removed, and the ore is mined through an opening at the surface.
    a. quarries  b. shaft mines  c. shallow mines  d. strip mines

13. In underground mines, _______ is used to prevent a mine from collapsing and to dispose of gangue.
    a. stripping  b. backfilling  c. timbering  d. loading

14. In this country, one of the most pressing mining problems is _______.
    a. finding minerals  
    b. saving the environment
    c. increasing costs  d. maintaining safety
NAME ___________________________ DATE ____________________ CLASS _______________________

15. Nearly ______ percent of the automobiles in this country are recycled when they are no longer usable.
   a. 20  b. 40  c. 70  d. 90

16. Recycling a stack of newspapers one meter high saves _______.
   a. a few pennies  b. a tree  c. someone's job  d. time

17. When ore is processed, nonmetallic materials called ______ are removed.
   a. slush  b. gangue  c. minerals  d. rocks

18. An alloy of iron that is much stronger than iron is _______.
   a. gold  b. metal  c. steel  d. chrome

19. Acid mine water can be reduced by _______.
   a. closing the mine  b. mining the sulfur  c. treating the water  d. flooding the mine with water

20. By _______. we reduce the amount of energy needed to produce products from natural resources.
    a. mining  b. polluting  c. recycling  d. disposing

Match the items in Column I with the correct terms or phrases in Column II. Write the letter on the line.

<table>
<thead>
<tr>
<th>Column I</th>
<th>Column II</th>
</tr>
</thead>
<tbody>
<tr>
<td>21. marble</td>
<td>a. ceramics</td>
</tr>
<tr>
<td>22. fluorite</td>
<td>b. building material</td>
</tr>
<tr>
<td>23. galena</td>
<td>c. abrasive</td>
</tr>
<tr>
<td>24. sand</td>
<td>d. iron</td>
</tr>
<tr>
<td>25. nitrate</td>
<td>e. lead</td>
</tr>
<tr>
<td>26. magnetite</td>
<td>f. radium</td>
</tr>
<tr>
<td>27. graphite</td>
<td>g. pencil lead</td>
</tr>
<tr>
<td>28. diamond</td>
<td>h. fertiliser</td>
</tr>
<tr>
<td>29. quartz</td>
<td>i. toothpaste ingredient</td>
</tr>
<tr>
<td>30. clay</td>
<td>j. glass</td>
</tr>
</tbody>
</table>
III. Applying Concepts

Determine whether each of the following statements is true or false. Write the word "true" or "false".

_____________ 1. Quartz is an example of a sedimentary mineral.

_____________ 2. Quarries are open pit mines from which sandstone or limestone is removed.

_____________ 3. Metallic ores often contain more than one metal.

_____________ 4. Copper is a common by-product of gold ores.

_____________ 5. Malleable means being able to be shaped by pounding without losing strength.

_____________ 6. Graphite and diamond can be used for the same thing.

_____________ 7. Magnetite is used to make pencil lead.

_____________ 8. Some gems are formed when molten rock is pushed into cracks of rocks.

_____________ 9. Gangue is the ore before it is separated into metal and waste.

_____________ 10. Only coal mines can be reclaimed.

_____________ 11. Backfilling is a first step in reclaiming strip mines.

_____________ 12. Only aluminum cans are worth recycling.

_____________ 13. Placers are deposits that form when ore is carried by water and deposited where the water slows down.

_____________ 14. SEMMP is the Southeastern Environmental Mining Program and is focused on preventing adverse effects of strip mines on the environment.

_____________ 15. Alloys are blends of metals that may improve the properties of each.
Reviewing Concepts

Choose the word or phrase that correctly completes each of the following sentences.

1. High-temperature vein deposits are formed by (contact metamorphism, fluids from magma, alloys).

2. Heavy minerals sink to the bottom of the magma chamber in (igneous, contact metamorphic, sedimentary) ore deposits.

3. (Gold, Silver, Graphite) is a nonmetallic mineral.

4. The hardest known natural substance is (iron, diamond, gold).

5. (Graphite, Sandstone, Silver) is associated with contact metamorphic deposits.

6. Marble and sandstone are removed from (strip mines, quarries, shaft mines).

7. Phosphates, nitrates, and potash are used in (ceramics, fertilizers, building materials).

8. Coal, gold, and gravel are (nonrenewable resources, renewable resources, minerals).

9. (Metals, Crystals, Nonmetals) can be shaped by pounding without loss of strength.

10. At least (20, 8, 35) nonmetallic materials are necessary to industry.

11. Nickel, copper, and lead are (nonmetallic, metallic, sedimentary) ore deposits.

12. The process used to refine metals is (smelting, recycling, backfilling).

13. The original source of all Earth’s rock and minerals is (contact metamorphic deposits, metallic ore, magma).

14. Steel is a(n) (alloy, nonmetal, high-temperature vein deposit).

15. When groundwater comes in contact with pyrite, (an alloy, sulfuric acid, gangue) is formed.
TEACHERS’ LEARNING GOALS COMPARED TO STANDARDS AND BENCHMARKS

Teacher Code: T5A

Teacher’s Objectives (written in lesson plans):

The Learner Will

1. consider how we know about living things that lived more than 570 million years ago by brainstorming
2. observe that soft plant parts are less likely than woody parts to become preserved as fossils by completing “Try This” activity: What remains?
3. become familiar with the vocabulary Lesson 4 p. 58 by defining in notebook.
4. review vocabulary of Lesson 4 by checking orally.
5. formulate a model of one method of fossil preservation by completing Explore Activity—Making a Good Impression p. 60-61
6. learn about fossils, the fossil record and the Precambrian by reading p. 62-67.
7. review facts of prior lesson by checking questions orally.

National Standards/Benchmarks

National Science Standard: Earth and Space Science, content Standard D:
As a result of their activities in grades 5-8, all students should develop an understanding of

• Structure of the earth system
• Earth’s history
  o The earth processes we see today, including erosion, movement of lithosphere plates, and changes in atmospheric composition, are similar to those that occurred in the past, earth history is also influenced by occasional catastrophes, such as the impact of an asteroid or comet.
  o Fossils provide important evidence of how life and environmental conditions have changed.
• Earth in the solar system (NRC, 1996, p. 158)

Benchmarks for Science Literacy

p. 72 Grades 3-5
Students should now observe elementary processes of the rock cycle—erosion, transport, and deposit....Later, they can connect the features to the processes and follow explanations of how the features came to be and still are changing.

By the end of the 5th grade, students should know that
• Waves, wind, water, and ice shape and reshape the earth's land surface by eroding rock and soil in some areas and depositing them in other areas, sometimes in seasonal layers.

• Rock is composed of different combinations of minerals. Smaller rocks come from the breakage and weathering of bedrock and larger rocks. Soil is made partly from weathered rock, partly from plant remains—and also contains many living organisms.

Grades 6 through 8
Benchmark 4C, The Physical Setting: Processes that Shape the Earth
• #5 Thousands of layers of sedimentary rock confirm the long history of the changing surface of the earth and the changing life forms whose remains are found in successive layers. The youngest layers are not always found on top, because of folding, breaking, and uplift of layers (AAAS, 1993, p. 73)

p. 271 Constancy and changes

Somewhat different aspects of constancy are described by the terms stability, conservation, equilibrium, steady state, and symmetry. The first step is to encourage children to attend to change and describe it.

p. 273 grades 3-5
• Things change in steady, repetitive, or irregular ways—or sometimes in more than one way at the same time. Often the best way to tell which kinds of change are happening is to make a table or graph of measurements.

State Standards/Benchmarks

Louisiana Standard: Earth and Space Science
The students will develop an understanding of the properties of earth materials, the structure of the Earth system, the Earth’s history, and the Earth’s place in the universe (DOE, 1997, p. 41).

Louisiana Benchmarks: Earth History Grades 5-8
• ESS-M-B1 investigating how fossils show the development of life over time; (2,3,4)
• ESS-M-B2 devising a model that demonstrates supporting evidence that the Earth has existed for a vast period of time
• ESS-M-B3 understanding that earth processes such as erosion and weathering affect the Earth today and are similar to those which occurred in the past (1,2,3,4) (DOE, 1997, p. 43)

• Louisiana Benchmarks: Earth and Space Science: Structure of the Earth Grades 5-8 1) ESS-M-A5 identifying the characteristics and uses of
minerals and rocks and recognizing that rocks are mixtures of minerals, and 2) ESS-M-A6 explaining the processes involved in the rock cycle (DOE, 1997, p. 43)

Louisiana Benchmarks: Earth and Space Science:
A. Properties of earth materials Grades K-4
   - ESS-E-7 investigating fossils and describing how they provide evidence about plants and animals that lived long ago and the environment in which they lived.

Regional Benchmarks:
Regional Sub strand A: Characteristics, Structure, and History
   - #9 Identify fossils as the reserved remains of ancient plant and animals

Grade 6: Earth and Space Science Regional Sub strand A: Characteristics, Structure, and History
   - Examine evidence which supports continental drift.
   - Recognize that constructive and destructive forces affecting earth today have occurred throughout geologic time
   - Construct a geologic time line indicating geologic eras, and showing examples from fossil evidence of how organism have changed

Regional Grade 4: Earth and Space Science Regional Sub strand A: Characteristics, Structure, and History
   - Explore by observing that rocks are mixtures of various substances (minerals).
   - Explore erosion, weathering, and deposition.

Parish Concept Grid:

Grade 5
   - Fossil Formation
Teacher Code: T5B
Teacher's Objectives (written in lesson plans):

1. Define rivers, marsh, and swamps
2. Describe the relationship between the land and water
3. Describe the Mississippi River and the Louisiana swamps
4. Define ecosystem, terrestrial aquatic and anaerobic
5. Describe the five wetland systems
6. Read and understand the features on a topographic map
7. To develop an awareness of the functions and values of wetlands
8. To understand the relationship between healthy wetlands and the quality of life in the Lake Pontchartrain Basin
9. To demonstrate understanding of the cause and effect relationship between wetland loss and other environmental issues in the Lake Pontchartrain Basin
10. Define a watershed
11. Describe the relation between land and water in the wetlands
12. Describe the Lake Pontchartrain Basin

National Standards/Benchmarks

National Science Standard: Life Science: Content Standard C:
As a result of their activities in grades 5-8, all students should develop understanding of

- Structure and function in living systems
- Reproduction and heredity
- Regulation and behavior
- Populations and ecosystems
- Diversity and adaptations of organisms (NRC, 1996, p.157)

NSES Content Standard C: Life Science Grades 5-8 Populations and Ecosystems:

1. A population consists of all individuals of a species that occur together at a given place and time. All populations living together and the physical factors with which they interact compose an ecosystem,

2. Populations of organisms can be categorized by the function they serve in an ecosystem. Plants and some microorganisms are producers—they make their own food. All animals, including humans, are consumers, which obtain food by eating other organisms. Decomposers, primarily bacteria and fungi, are consumers that use waste materials and dead organisms for food. Food webs identify the relationships among producers, consumers, and decomposers in an ecosystem,

3. For ecosystems, the major source of energy is sunlight. Energy entering ecosystems as sunlight is transferred by producers into chemical energy through photosynthesis. That energy then passes from organism to organism in food webs,

4. The number of organisms an ecosystem can support depends on the resources available and abiotic factors, such as quantity of light and water, range of
temperatures, and soil composition. Given adequate biotic and abiotic resources and no disease or predators, populations (including humans) increase at rapid rates. Lack of resources and other factors, such as predation and climate, limit the growth of populations in specific niches in the ecosystem (NRC, 1996, p. 157)

National Science Standard: Earth and Space Science: structure of the earth system

- Water, which covers the majority of the earth's surface, circulates through the crust, oceans, and atmosphere in what is known as the 'water cycle.' Water evaporates from the earth's surface, rises and cools as it moves to higher elevations, condenses as rain or snow, and falls to the surface where it collects in lakes, oceans, soil, and in rocks underground.
- Water is a solvent. As it passes through the water cycle it dissolves minerals and gases and carries them to the oceans (NRC, 1996, p.157)

Benchmarks for Science Literacy

Benchmarks on-line Grades 6 through 8

As students build up a collection of cases based on their own studies of organisms, readings, and film presentations, they should be guided from specific examples of the interdependency of organisms to a more systematic view of the kinds of interactions that take place among organisms. But a necessary part of understanding complex relationships is to know what a fair proportion of the possibilities are. The full-blown concept of ecosystem (and that term) can best be left until students have many of the pieces ready to put in place. Prior knowledge of the relationships between organisms and the environment should be integrated with students' growing knowledge of the earth sciences.

- In all environments—freshwater, marine, forest, desert, grassland, mountain, and others—organisms with similar needs may compete with one another for resources, including food, space, water, air, and shelter. In any particular environment, the growth and survival of organisms depend on the physical conditions.
- Two types of organisms may interact with one another in several ways: They may be in a producer/consumer, predator/prey, or parasite/host relationship. Or one organism may scavenge or decompose another. Relationships may be competitive or mutually beneficial. Some species have become so adapted to each other that neither could survive without the other

p. 69 The Physical Setting: 4B The Earth Grades 6-8

- #7 The cycling of water in and out of the atmosphere plays an important role in determining climatic patterns. Water evaporates from the surface of the earth, rises and cools, condenses into rain or snow, and falls again to the
surface. The water falling on land collects in rivers and lakes, soil, and porous layers of rock, and much of it flows back into the ocean.

- #8 Fresh water, limited in supply, is essential for life and also for most industrial processes. Rivers, lakes, and groundwater can be depleted or polluted, becoming unavailable or unsuitable for life.

Louisiana Content Standards/Benchmarks

Louisiana Standard: Life Science
The students will become aware of the characteristics and life cycles of organisms and understand their relationships to each other and to their environment (DOE, 1997, p. 34)

Louisiana Standard: Science and the Environment
In learning environmental science, students will develop an appreciation of the natural environment, learn the importance of environmental quality, and acquire a sense of stewardship. As consumers and citizens, they will be able to recognize how our personal, professional, and political actions affect the natural world (DOE, 1997, p. )

Life Science: C. Populations and Ecosystems
LS-M-C3 investigating major ecosystems and recognizing physical properties and organisms within each (p. 37)

Louisiana Benchmarks: Life Science: Adaptations of Organisms Grades 5-8
- LS-M-D1 describing the importance of plant and animal adaptation, including local examples (DOE, 1997, p.37)

Louisiana Benchmarks: Science and the Environment Grades K-4
- SE-E-A5 understanding that most plant and animal species are threatened or endangered today due to habitat loss or change (DOE, 1997, p. )

Louisiana Benchmarks: Science and the Environment Grades 5-8
- SE-M-A1 demonstrating knowledge that an ecosystem includes living and nonliving factors and the humans are an integral part of ecosystems (DOE, 1997, p. )

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Teacher Code: T6A

Teacher's Objectives (written on chalkboard):

1. The learner will (TLW) use a simple balance to weigh air.
2. TLW experiment to discover what happens when hot and cold air come together.
3. TLW construct a concept map to review concepts about the Earth’s atmosphere.

Textbook Theme: Systems and Interactions

Earth’s atmosphere is a system that interacts with the sun and Earth. In this lesson, students study the atmosphere’s interaction on differing scales. For example, its chemical structure changes as its components interact with other substances, living things, and the sun. On a larger scale, the layers in its structure interact with each other, Earth, and solar energy.

National Standards/Benchmarks

Standard D Earth and Space Science: Structure of the Earth system Grades 5-8
- The atmosphere is a mixture of nitrogen, oxygen, and trace gases that include water vapor. The atmosphere has different properties at different elevations.
- Water, which covers the majority of the earth’s surface, circulates through the crust, oceans, and atmosphere in what is known as the “water cycle.” Water evaporates from the earth’s surface, rises and cools as it moves to higher elevations, condenses as rain or snow, and falls to the surface where it collects in lakes, oceans, soil and in rocks underground.
- Clouds, formed by the condensation of water vapor, affect weather and climate (NRC, 1996, p.158)

Standard D Earth and Space Science: Earth in the Solar System Grades 5-8
- The sun is the major source of energy for phenomena on the earth’s surface, such as the growth of plants, winds, ocean currents, and the water cycle.
- Seasons result from variations in the amount of the sun’s energy hitting the surface, due to the tilt of the earth’s rotation on its axis and the length of the day.

Benchmarks for Science Literacy

Benchmark 4B The Physical Setting: The Earth, Grades 3-5.
- When liquid water disappears, it turns into a gas (vapor) in the air and can reappear as a liquid when cooled, or as a solid if cooled below the freezing point of water. Clouds and fog are made of tiny droplets of water, and
- Air is a substance that surrounds us, takes up space, and whose movement we feel as wind (AAAS, 1993)
Benchmark 4B  The Physical Setting: The Earth, Grades 6-8

- The cycling of water in and out of the atmosphere plays an important role in determining climatic patterns. Water evaporates from the surface of the earth, rises and cools, condenses into rain or snow, and falls again to the surface. The water falling on land collects in rivers and lakes, soil, and porous layers of rock, and much of it flows back into the ocean (AAAS, 1993)

Benchmark 4C  The Physical Setting: Processes that Shape the Earth, Grades 9-12

- Plants alter the earth’s atmosphere by removing carbon dioxide from it, using the carbon to make sugars and releasing oxygen. This process is responsible for the oxygen content of the air (AAAS, 1993)

Louisiana Content Standards/Benchmarks

Earth and Space Science Standard

The students will develop an understanding of the properties of earth materials, the structure of the Earth system, the Earth’s history, and the Earth’s place in the universe (p.41).

Louisiana Benchmarks

Earth and Space Science B. Objects in the Sky Grades K-4

- ESS E B5 understanding that the sun, a star is a source of heat and light energy and identifying its effects upon the earth (p.42)

Regional Substrand A: Characteristics, Structure, and History

- Explore characteristics of the atmospheric layers with an emphasis on the effects of human activity
Teacher Code: T6B
Teacher's Objectives

Did not have learning goals written into lesson plans.
Did not have learning goals written on the chalk board.

Teacher Code: T7A
Teacher's Objectives

No lesson plans available.
Did not have learning goals written on the chalk board.
Teacher Code: T7B
Teacher’s Objectives (written in lesson plans)

1. The learner will (TLW) construct fossil model
2. TLW design and describe life characteristics of fossil model
3. TLW define the term paleontologist
4. TLW construct a symmetric vertebrate skeleton model
5. TLW apply prior knowledge to draw a dinosaur based on skeleton model
6. TLW design, depict an environment based on previous models and examples that shows the Mesozoic era and accurately draw plants, geology murals, and food chain.

National Standards/Benchmarks

Standard C Life Science: Diversity and adaptations of organisms Grades 5-8
Extinction of a species occurs when the environment changes and the adaptive characteristics of a species are insufficient to allow survival. Fossils indicate that many organism that lived long ago are extinct. Extinction of species is common; most of the species that have lived on the earth no longer exist.

Standard C Life Science: Diversity and adaptations of organisms Grades 5-8
Millions of species of animals, plants, and micro-organisms are alive today. Although different species might look dissimilar, the unity among organisms becomes apparent from an analysis of internal structures, the similarity of their chemical processes, and the evidence of common ancestry.

Standard C Life Science: Populations and ecosystems Grades 5-8
For ecosystems, the major source of energy is sunlight. Energy entering ecosystems as sunlight is transferred by producers into chemical energy through photosynthesis. That energy then passes from organism to organism in food webs.

Standard C Life Science: Regulation and behavior
All organisms must be able to obtain and use resources, grow, reproduce, and maintain stable internal conditions while living in a constantly changing external environment.

Standard C Life Science: Structure and function in living systems Grades 5-8
Living systems at all levels of organization demonstrate the complementary nature of structure and function. Important levels of organization for structure and function include cells, organs, tissues, organ systems, whole organisms, and ecosystems.

Standard D Earth and Space Science: Earth’s History
Fossils provide important evidence of how life and environmental conditions have changed.

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Evolution is a series of changes, some gradual and some sporadic, that accounts for the present form and function of objects, organisms, and natural and designed systems. The general idea of evolution is that the present arises from materials and forms of the past. Although, evolution is most commonly associated with biological theory explaining the process of descent with modification of organisms from common ancestors, evolution also describes changes in the universe.

Models are tentative schemes or structures that correspond to real objects, events, or classes of events, and that have explanatory power. Models help scientists and engineers understand how things work. Models take many forms, including physical objects, plans, mental constructs, mathematical equations, and computer simulations.

Benchmarks for Science Literacy

Benchmark 1B The Nature of Science: Scientific Inquiry Grades 6-8
- Scientists differ greatly in what phenomena they study and how they go about their work. Although there is no fixed set of steps that all scientists follow, scientific investigations usually involve the collection of relevant evidence, the use of logical reasoning, and the application of imagination in devising hypotheses and explanations to make sense of the collected evidence.

Benchmark 1C The Nature of Science: The Scientific Enterprise Grades 3-5
- Clear communication is an essential part of doing science. It enables scientists to inform others about their work, expose their ideas to criticism by other scientists, and stay informed about scientific discoveries around the world.

Benchmark 5A The Living Environment: Diversity of Life Grades 6-8
- Similarities among organisms are found in internal anatomical features, which can be used to infer the degree of relatedness among organisms. In classifying organisms, biologists consider details of internal and external structures to be more important than behavior or general appearance.

Benchmark 5E The Living Environment: Flow of Matter and Energy Grades 6-8
- Food provides the molecules that serve as fuel and building materials for all organisms. Plants use the energy from light to make sugars from carbon dioxide and water. This food can be used immediately or stored for later use. Organisms that eat plants break down the plant structures to produce
the materials and energy they need to survive. Then they are consumed by other organisms.

Benchmark 5F The Living Environment: Evolution of Life Grades 6-8
- Individual organisms with certain traits are more likely than others to survive and have offspring. Changes in environmental conditions can affect the survival of individual organisms and entire species.

Benchmark 5F The Living Environment: Evolution of Life Grades 9-12
- The basic idea of biological evolution is that the earth’s present-day species developed from earlier, distinctly different species.

Louisiana State Standards/Benchmarks Grades 5-8

Earth and Space Science Standard:
The students will develop an understanding of the properties of earth materials, the structure of the Earth system, the Earth’s history, and the Earth’s place in the universe.

A. Structure of the Earth
- ESS-M-A1 understanding that the Earth is layered by density with an inner and outer core, a mantle, and a thin outer crust (1)

B. Earth History
- ESS-M-B1 investigating how fossils show the development of life over time (2,3,4)
- ESS-M-B2 devising a model that demonstrates supporting evidence that the Earth has existed for a vast period of time (1,2,3,4)

Life Science Standard:
The students will become aware of the characteristics and life cycles of organisms and understand their relationships to each other and to their environment.

A. Structure and function in living systems
- LS-M-A5 investigating human body systems and their functions (including circulatory, digestive, skeletal, respiratory) (1,3,4)
Teacher’s Objectives (written in lesson plans):

1. Investigating and describing the movement of heat and the effects of heat in objects and systems.
2. Evaluate energy sources and the effects of their use on the environment.
3. Investigating and describing the movement of heat and their effects of heat in objects and system.

National Standards/Benchmarks

National Science Standard: Physical Science B: Grades 5-8
As a result of their activities in grades 5-8, all students should develop an understanding of properties and changes of properties in matter, motions and forces, and transfer of energy (p.149)

Transfer of energy:

• Energy is a property of many substances and is associated with heat, light, electricity, mechanical motion, sound, nuclei, and the nature of a chemical. Energy is transferred in many ways.
• Heat moves in predictable ways, flowing from warmer objects to cooler ones, until both reach the same temperature.
• Light interacts with matter by transmission (including refraction), absorption, or scattering (including reflection). To see an object, light from that object—emitted by or scattered from it—must enter the eye.
• Electrical circuits provide a means of transferring electrical energy when heat, light, sound, and chemical changes are produced.
• In most chemical and nuclear reactions, energy is transferred into or out of a system. Heat, light, mechanical motion, or electricity might all be involved in such transfers.
• The sun is a major source of energy for changes on the earth’s surface. The sun loses energy by emitting light. A tiny fraction of the light reaches the earth, transferring energy from the sun to the earth. The sun’s energy arrives as light with a range of wavelengths, consisting of visible light, infrared, and ultraviolet radiation.

Benchmarks for Science Literacy

Benchmarks 4E The Physical Setting: Energy Transformations Grades 6-8
• Energy cannot be created or destroyed, but only changed from one form into another.
• Most of what goes on in the universe—from exploding stars and biological growth to the operation of machines and the motion of people—involves some form of energy being transformed into another. Energy in the form of heat is almost always one of the products of an energy transformation.

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• Heat can be transferred through materials by the collisions of atoms or across space by radiation. If the material is fluid, currents will be set up in it that aid the transfer of heat.

• Energy appears in different forms. Heat energy is in the disorderly motion of molecules and in radiation; chemical energy is in the arrangement of atoms; mechanical energy is in moving bodies or in elastically distorted shapes; and electrical energy is in the attraction or repulsion between charges.

LA Content Standards/Benchmarks

State Standard:
Students will develop an understanding of the characteristics and interrelationships of matter and energy in the physical world: C. Transformations of Energy (p. 29)

State Benchmarks:
• PS-M-C5 Investigating and describing the movement of heat and the effects of heat in objects and systems (2,3,4)
• PS-M-C8 Comparing the uses of different energy resources and their effects upon the environment (1,2,3,4,5)
• PS-M-C2 Understanding the different kinds of energy transformations and the fact the energy can be neither destroyed nor created (2,3,4)
Teacher Code: T8B

Teacher’s Objectives (written in lesson plans):

1. The learner will (TLW) discuss test papers given Friday.
2. TLW begin decoding notes from Chap. 24 Mineral Resources.
3. TLW discuss decoded notes given previous day
4. TLW begin defining vocabulary words from Chap. 24
5. TLW complete assignment given previous day
6. TLW begin answering vocabulary review worksheet
7. TLW discuss meanings of vocabulary words
8. TLW complete vocabulary review worksheet as review for vocabulary quiz Friday
9. TLW be evaluated on knowledge of meanings of vocabulary words
10. TLW begin answering questions from Chap. 24
11. TLW discuss blue questions and vocabulary review worksheet
12. TLW begin answering study guide
13. TLW complete study guide
14. TLW begin answering worksheet on renewable and non renewable resources
15. TLW discuss study guide and worksheet on natural resources
16. TLW begin answering evaluation worksheet
17. TLW report to computer lab to work on environment program
18. TLW complete evaluation worksheet
19. TLW begin answering review questions

National Standards/Benchmarks

Content Standard D Earth and Space Science: Properties of Earth materials Grades K-4

Earth materials are solid rocks and soils, water, and the gases of the atmosphere. These varied materials have different physical and chemical properties, which make them useful in different ways, for example, as building materials, as sources of fuel, or for growing the plants we use as food. Earth materials provide many of the resources that humans use.

Science Content Standard F: Science in Personal and Social Perspectives: Natural resources Grades 9-12

The earth does not have infinite resources; increasing human consumption places severe stress on the natural processes that renew some resources, and it depletes those resources that cannot be renewed.

Science Content Standard F: Science in Personal and Social Perspectives: Natural hazards Grades 5-8

Human activities also can induce hazards through resource acquisition, urban growth, land-use decisions, and waste disposal. Such activities can accelerate many natural changes.
Benchmark 4B The Physical Setting: The Earth Grades 6-8

- Some minerals are very rare and some exist in great quantities, but—for practical purposes—the ability to recover them is just as important as their abundance. As minerals are depleted, obtaining them becomes more difficult. Recycling and the development of substitutes can reduce the rate of depletion but may also be costly.

Benchmark 4B The Physical Setting: The Earth Grades 6-8

- The benefits of the earth’s resources—such as fresh water, air, soil, and trees—can be reduced by using them wastefully or by deliberately or inadvertently destroying them. The atmosphere and the oceans have a limited capacity to absorb wastes and recycle materials naturally. Cleaning up polluted air, water, or soil or restoring depleted soil, forests, or fishing grounds can be very difficult and costly.

Benchmark 4C The Physical Setting: Processes that Shape the Earth Grades 6-8

- Human activities, such as reducing the amount of forest cover, increasing the amount and variety of chemicals released into the atmosphere, and intensive farming, have changed the earth’s land, oceans, and atmosphere. Some of these changes have decreased the capacity of the environment to support some life form.

Benchmark 8C The Designed World: Energy Sources and Use Grades 6-8

- Different ways of obtaining, transforming, and distributing energy have different environmental consequences.

Louisiana State Standards/Benchmarks

Science and the Environment Standard:

In learning environmental science, students will develop an appreciation of the natural environment, learn the importance of environmental quality, and acquire a sense of stewardship. As consumers and citizens, they will be able to recognize how our personal, professional, and political actions affect the natural world.

State Benchmarks 5-8

- SE-M-A3 Defining the concept of pollutant and describing the effects of various pollutants on ecosystems (1,2,3,4,5)
- SE-M-A4 Understanding that human actions can create risks and consequences in the environment (1,2,3,4,5)
- SE-M-A6 Distinguishing between renewable and nonrenewable resources and understanding that non renewable natural resources are not replenished through the natural cycles and thus are strictly limited in quantity (1,2,3,4,5)
APPENDIX K

SCIENCE FOR ALL AMERICANS CHAPTER 2 TOPIC OUTLINE

I. General
   A. Learning is not necessarily an outcome of teaching
   B. What students learn is influenced by their existing ideas
   C. Progression in learning is usually from the concrete to the abstract
   D. People learn to do well only what they practice doing
   E. Effective learning by students requires feedback
   F. Expectations affect performance

II. Specific to Science teaching
   A. Teaching should be consistent with the nature of scientific inquiry
      B. To understand them as ways of thinking and doing, as well as bodies of
         knowledge, requires that students have some experience with the kinds
         of thought and action that are typical of those fields. Teachers,
         therefore, should do the following:
         1. Start with questions about nature
         2. Engage students actively
         3. Concentrate on the collection and use of evidence
         4. Provide historical perspectives
         5. Insist on clear expression
         6. Use a team approach
         7. Do not separate knowing from finding out
   B. De-emphasize the memorization of technical vocabulary
   D. Science teaching should reflect scientific values.
      1. Welcome curiosity
      2. Reward creativity
      3. Encourage a spirit of healthy questioning
      4. Avoid dogmatism
      5. Promote aesthetic responses
   E. Science teaching should aim to counteract learning anxieties
      1. Build on success
      2. Provide abundant experience in using tools
      3. Support the roles of girls and minorities in science
      4. Emphasize group learning
   F. Science teaching should extend beyond the school
   G. Teaching should take its time
APPENDIX L

FREQUENCY OF USE BY TEACHER’S ASSESSMENT ACTIVITY AND TEACHER CERTIFICATION (in number of respondents)

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FREQUENCY OF USE BY STUDENT'S ASSESSMENT ACTIVITY AND TEACHER CERTIFICATION
(in number of respondents)

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<td></td>
<td>Always</td>
<td>16</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>$\chi^2 = 4.392$, N.S.</td>
<td></td>
</tr>
<tr>
<td>Work on Portfolios</td>
<td>Never</td>
<td>56</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>Rarely</td>
<td>35</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Sometimes</td>
<td>28</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>Often</td>
<td>19</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Always</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>$\chi^2 = 6.191$, N.S.</td>
<td></td>
</tr>
<tr>
<td>Take Multiple Choice, Fill-in-the-Blank, and Matching Tests</td>
<td>Never</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Rarely</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Sometimes</td>
<td>47</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>Often</td>
<td>76</td>
<td>11</td>
</tr>
<tr>
<td></td>
<td>Always</td>
<td>24</td>
<td>3</td>
</tr>
<tr>
<td></td>
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<td>$\chi^2 = .486$, N.S.</td>
<td></td>
</tr>
<tr>
<td>Take Tests Requiring Open-ended Responses (Descriptions, Explanations)</td>
<td>Never</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Rarely</td>
<td>9</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Sometimes</td>
<td>54</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>Often</td>
<td>69</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td>Always</td>
<td>14</td>
<td>2</td>
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<tr>
<td></td>
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<td>$\chi^2 = 1.549$, N.S.</td>
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<tr>
<td>Engage in Performance Tasks for Assessment Purposes</td>
<td>Never</td>
<td>6</td>
<td></td>
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<tr>
<td></td>
<td>Rarely</td>
<td>24</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Sometimes</td>
<td>66</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>Often</td>
<td>41</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td>Always</td>
<td>9</td>
<td>2</td>
</tr>
<tr>
<td></td>
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<td>$\chi^2 = 3.107$, N.S.</td>
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</tbody>
</table>
Kathy Jean McWaters is currently the Title I Coordinator for Curriculum and Staff Development for St. John the Baptist Public Schools. Prior to this, she was employed as a science specialist for the Garyville/Mt. Airy Math and Science Magnet School (1995-1999). She taught science (earth science, physical science, biology, and chemistry) in south Louisiana middle schools and high schools from 1974-1995. Before embarking on her science teaching career, she was employed by Louisiana State University (1970-73) as a 4-H Extension Agent and by Florida State University (1973-1974) as both a 4-H Agent and Home Demonstration Extension Agent.

Ms. McWaters received the bachelor of science degree from Louisiana State University in May, 1969, with a major in vocational home economics education, the master of science degree from Louisiana State University in August, 1970, and education specialist certification from Louisiana State University in December, 1996. She is certified to teach chemistry, biology, physical science and home economics in the state of Louisiana and to supervise student teachers. Ms. McWaters has authored or coauthored presentations for the National Association for Research in Science Teaching, the National Science Teachers Association, and the Louisiana State Science Teachers Association. She has been actively involved in promoting science reform in the state of Louisiana working as a site coordinator (1993-1994) and an assessment consultant (1995-1998) for projects that were funded by the Louisiana Systemic Initiative Program. She will receive the degree of Doctor of Philosophy from Louisiana State University in August, 2001.
DOCTORAL EXAMINATION AND DISSERTATION REPORT

Candidate: Kathy Jean McWaters

Major Field: Curriculum and Instruction

Title of Dissertation: An Exploratory Study of the Influence of National and State Standards on Middle School Science Teachers' Classroom Assessment Practices

Approved:

[Signatures]

EXAMINING COMMITTEE:

[Signatures]

Date of Examination:

April 27, 2001