Appendix L

Comprehensive Mathematics and Science Plan-
Mathematics and Science Literacy:
Bridges to Careers

Miami-Dade County Public Schools (M-DCPS) faces great challenges and has very critical needs in terms of educational support for the students of this diverse community. Implementing programs to narrow the achievement gap for mathematics and science and providing more opportunities for minority students is a district priority. It is essential to emphasize that the single most powerful determinant of student success in mathematics and science is excellent teaching. As a result, the Miami-Dade County School Board funded a comprehensive mathematics and science plan, entitled *Mathematics and Science Literacy - Bridges to Careers* for all district schools in March of 2000 which is an integral component of the District's National Science Foundation's Urban Systemic Program (USP).

For sustainability of mathematics and science reform to occur across the entire district, a model of school-site professional development has been implemented. At the core of this model is the requirement that every school implement a mathematics and science instructional improvement team. The Instructional Improvement Team (IIT) is a team of school-site leaders that meet to assist the principal in making important data-driven decisions about the mathematics and science instruction that will have a direct impact on student achievement. This approach is designed to help build a culture of continuous learning among the faculties of Miami-Dade public schools, and a commitment to on-going improvement in the quality of teaching and learning.

To facilitate this process, the Division of Mathematics and Science Education has hired mathematics and science educational specialists to work with specific elementary and secondary schools that are clustered by feeder patterns. The role of these educational specialists is to meet the specific school-site needs for professional development and to facilitate the instructional improvement teams, as well as working with school-site administrators in the following capacity:

- Facilitating the implementation of the Mathematics and Science Instructional Improvement Team to promote leadership among the team and help identify professional development needs in curriculum content and instructional strategies for district mathematics and science teachers;

- Assisting the Instructional Improvement Team in using school-wide data to set school goals and make decisions about mathematics and science curriculum, instruction, and assessment;

- Deepening the content knowledge of all mathematics and science teachers;

- Providing modeling of teaching strategies to the mathematics and science teachers at the assigned school site;

- Coaching and assisting early career teachers in the curriculum areas of mathematics and science and the development of their individual Professional Development Plan;

- Implementing the protocols involved in examining student work with mathematics and science teachers as a reflective process in order to increase student achievement;

- Providing teachers positive and informative feedback that will enhance their professional growth;

- Assisting in the development of classroom assessment tasks that promote higher-order thinking skills in mathematics and science with a focus on the mathematics and science performance on the Florida Comprehensive Assessment Test (FCAT) to guide these assessments;

- Assisting teachers in the examination of their expectations of their students; and

- Planning and implementing collaborative lessons based on research findings that support increased student achievement.

This type of model will allow for ongoing dialogue about what is working, what is not, and how the curriculum, instruction, and assessment should look in order to improve teaching and learning.

The following goals represent the most important intended outcomes of the District Comprehensive Plan and Urban Systemic Program. These goals should be achieved over the next three years, and sustained as regular occurrences in subsequent years.

1. All teachers will utilize on a daily basis best practices and instructional strategies that target curriculum, examining classroom practice, and collaboration among teachers.

2. School-wide Instructional Improvement Teams will be created to guide and implement professional development for mathematics and science at each school site.

3. All schools will be provided support by feeder pattern support teams that include Division educational specialists that are experts in mathematics and science.

4. All teachers will develop an individual professional development plan. These plans will focus on appropriate curriculum, instruction and assessment that support both local and national standards.

5. Division educational specialists will disseminate information to parents within the community regarding how the local, state, national and international standards in mathematics and science have increased.

6. Principals and assistant principals will receive professional development designed to support mathematics and science instruction at their school, to promote mathematics and science careers, and to improve the quality of programs at the school site.

7. Elementary teachers will deepen their content knowledge and comfort level in teaching mathematics and science concepts.

8. Elementary teachers will teach a sixty-minute block of mathematics and a thirty-minute block of science daily, or teachers may combine an integrated mathematics and science content into a ninety-minute block.

9. Middle school teachers will deepen their content knowledge and increase their capacity to teach mathematics and science concepts within the context of effective learning theory for middle school learners.

10. Middle school science teachers will utilize two lessons a week for laboratory activities that build conceptual development of science principles and their application to problem solving.

11. Senior high school teachers will increase the use of effective pedagogy such as contextual learning to deliver the mathematics and science content to students.

12. Senior high school science teachers will incorporate at least 100 minutes of laboratory experience per week into their instruction.

The M-DCPS Comprehensive Mathematics and Science Plan may be accessed at http://mathscience/dadeschools.net/ or you may contact the Division of Mathematics and Science Education at 305-995-1989.

MATHEMATICS AND SCIENCE LITERACY – BRIDGES TO CAREERS

Introduction

Business, industry, and government studies portray a compelling picture of the landscape of the 21st century workplace in the United States. More than ever, jobs will require a solid foundation of mathematics and science, the ability to apply important principles from these disciplines, and the ability to use technology to solve problems involving mathematics and science. Currently the United States is experiencing a critical shortage of engineers, to the extent that immigration policies are constantly changed to provide additional engineers to staff universities and technical industries.

To quote U.S. Secretary of Education, Richard W. Riley (1998), "Demand for skills in mathematics, science, and technology are continually increasing. To be successful in college and the workplace, students should take at least three years of rigorous high school math. We now believe that by the end of the eighth grade, students should have mastered the fundamentals of algebra and geometry to be ready for high school and on track for college and the workforce."

The workforce that will be needed for these jobs must have a threshold level of mathematics and science literacy beyond that which was necessary in the mid-twentieth century. These workers must be able to solve complex problems using mathematics and science principles and processes to successfully compete in a rapidly-paced international marketplace.

Recently, Assistant Secretary of Education, Patricia McNeil, asked an 11th grader who was interning in a job what he thought was the minimum level of mathematics necessary to perform the job of auto mechanic. The student-intern responded without hesitation, "Algebra 2."

Locally, the Greater Miami Chamber of Commerce's Community Long-Range Planning Committee projected a shortfall of at least 120,000 jobs by the year 2005, based primarily on infrastructure weaknesses. The One Community One Goal® initiative was developed to produce jobs through supporting the growth of targeted industries, such as, biomedical, information technology, and international commerce. The lack of a skilled and technically-qualified workforce has become the focal point for driving substantive, systemic changes in educational programs, content and experiences. Recognition of the practical "disconnect" between the school curriculum, related educational experiences, and the actual needs of a rapid-paced, international economy has reinforced the urgency for changes in the mathematics and science programs and for changes in the delivery system itself.

The preparation of a competent workforce for the Miami-Dade community requires essential and critical goals for student knowledge and skills. For mathematics these

goals are that every student who graduates from Miami-Dade County Public Schools will have completed a minimum of Algebra I, Geometry and Algebra II, and will be able to utilize mathematics principles to solve problems in real-life contexts. For science, these goals are that every student who graduates from Miami-Dade County Public Schools will have completed a minimum of Earth/Space Science, Biology, and Chemistry (or Physical Science), and will be able to utilize science principles to solve problems in real-life contexts. Miami-Dade County Public Schools' graduates will possess the mathematics and science literacy necessary for success in post-secondary education and as employees in the workplace. These graduates will be able to compete in the global marketplace for the jobs of the future.

The ability to apply the principles and concepts of mathematics and science to solve problems implies a level of technology literacy and experiences with the use of technology in mathematics and science. This will necessitate a successful and pervasive integration of technology use in both mathematics and science classrooms.

The goals may be viewed as the completed superstructure of the bridge to careers. As with all architectural designs, there are blueprints and foundations and necessary infrastructure. Miami-Dade's bridge to careers will include a blueprint – the curriculum. This bridge will include a foundation – the elementary school program. It will have scaffolding – the middle school program. This bridge must have a powerful infrastructure – a program of professional development and support for teachers. Miami-Dade's bridge will possess a shining superstructure – the senior high program. It is important to consider the recent efforts to improve mathematics and science that have prepared the school system for this venture.

Miami-Dade County Public Schools has benefited from five years of the Urban Systemic Initiative (USI), an extensive program funded by the National Science Foundation (NSF), to produce long-term change in mathematics and science education. Currently, district staff are preparing a proposal to the National Science Foundation for a five-year funding cycle under the Urban Systemic Program grant. The next generation of systemic reform in mathematics and science will be based on the essential features of this district comprehensive plan – *Mathematics and Science Literacy – Bridges to Careers*. While the USI was a K-12 initiative, the focus of the Miami-Dade effort was principally on the elementary school program. Consequently, the majority of resources and staff development activities centered on changing mathematics and science in grades K-5.

Achievement scores on the Mathematics Applications sub-test of the Stanford 8 reached an all-time high, with students at all elementary grade levels matching or exceeding the national median percentile. Science scores also went up at grades 3 and 5, although less substantially. The USI program has had less impact on student achievement at the secondary level. However, student enrollment in higher level courses did increase substantially, especially for minority students, as illustrated by the tables on the following page.

Total and Minority Enrollment in Selected Mathematics Courses, Base Year 1993-94 and 1998-99

Course	African American			Hispanic			All Students		
	Base Year	1998-99	+ Change from Base Year to '99	Base Year	1998-99	+ Change from Base Year to '99	Base Year	1998-99	+ Change from Base Year to '99
Algebra I	5,127	13,674	167%	8,730	21,742	149%	17,339	40,550	134%
Geometry	2,681	5,799	116%	5,035	9,595	91%	10,114	18,638	84%
Algebra II	2,064	3,881	88%	3,866	6,427	66%	8,179	13,012	59%
Pre-Calculus	458	947	107%	959	2,182	128%	2,110	4,368	107%

Total and Minority Enrollment in Selected Science Courses, Base Year 1993-94 and 1998-99

Course	African American			Hispanic			All Students		
	Base Year	1998-99	+ Change from Base Year to '99	Base Year	1998-99	+ Change from Base Year to '99	Base Year	1998-99	+ Change from Base Year to '99
Physical Science	6,641	8,441	27%	10,291	14,181	38%	20,618	26,578	29%
Biology	5,763	7,314	27%	9,387	11,993	28%	18,451	22,876	24%
Chemistry	2,532	3,535	40%	4,122	5,469	33%	8,969	11,502	28%
Physics	635	797	26%	1,573	1,896	21%	3,255	3,754	15%

Many hours of professional development have produced episodic changes in numerous classrooms, and have developed an excellent core group of teacher leaders. The type of sustained improvement in teaching practices that is necessary to accelerate student achievement at the secondary school level requires a renewed and more focused effort. This effort will concentrate on improving teaching practice.

It is essential to emphasize that the centerpiece for improved learning is excellent teaching. The daily work of classroom teachers in Miami-Dade Public Schools will be the single most powerful determinant of student success in mathematics and science and therefore the success of any plan to accelerate student ability to use mathematics and science in a meaningful context. A structured approach to improving capacity of teachers to teach the mathematics and science and to transforming teaching practices is the key to success.

Mathematics and science reform efforts, and the higher academic standards included in those efforts, require far-reaching and difficult changes in the practice of teaching mathematics and science. The new vision is one in which all students are engaged in

inquiry-based instruction and discovery. The students of Miami-Dade County Public Schools must acquire the ability to effectively problem solve, the ability to make real-world applications, and have a deep conceptual understanding of the content within these disciplines. These are compelling necessities not only for public accountability, but also for the public need for a competent workforce. To achieve this vision for every classroom and every student, teachers need new knowledge, skills, and behaviors. Therefore, teachers need opportunity for appropriate professional growth that nurtures the intellectual and leadership capacity of teachers and focuses on individual, collegial, and organizational improvement. The following seven principles should guide all professional development activities to ensure a positive impact on student learning and achievement:

1. Effective professional development experiences are driven by a well-defined image of effective classroom learning and teaching. This should include commitment to all children learning mathematics and science: an emphasis on inquiry-based learning, investigations, problem solving and applications of knowledge. Teachers should develop approaches that emphasize in-depth understanding of core concepts and challenge students to construct new understandings, and use assessment practices that measure meaningful achievement.

2. Effective professional development experiences provide opportunities for teachers to build knowledge and skills that not only include development of in-depth knowledge of subject matter, but also include applications of technology to enhance the curriculum and effective pedagogy.

3. Effective professional development experiences use or model with teachers the strategies teachers will use with their students. For example, they start at the point where teachers are and build from there. They provide ample time for in-depth investigations, including the use of technology to increase their proficiency, collaborative work, and reflection; and connect with teachers' other professional development activities.

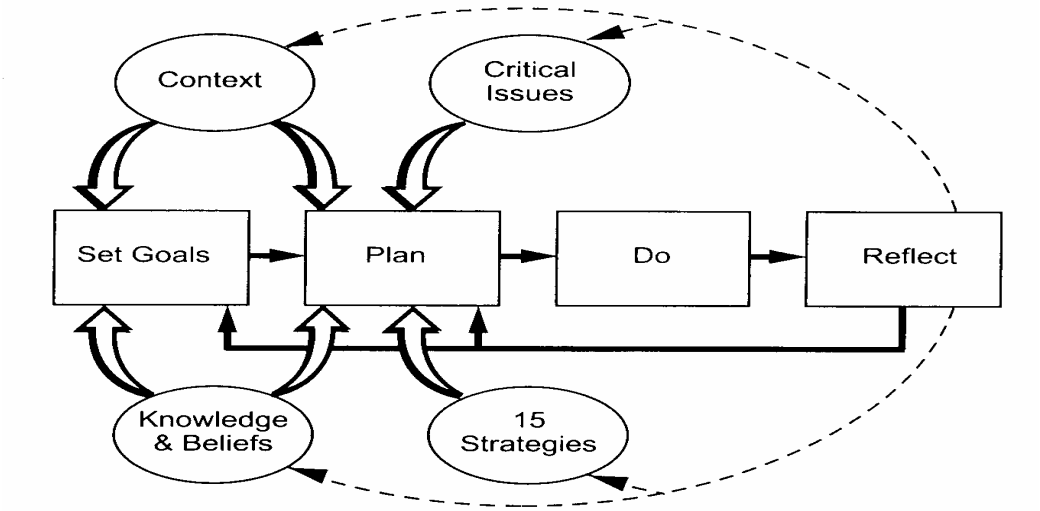
4. Effective professional development experiences build a learning community. Continuous learning becomes part of the school norms and culture; teachers are rewarded and encouraged to take risks and learn, and teachers learn and share together.

5. Effective professional development experiences support teachers to serve in leadership roles as supporters of other teachers, as agents of change, and as promoters of continuous improvement in teaching and learning.

6. Effective professional development experiences provide links to other parts of the education system. Professional development should be integrated with other district or school initiatives, state and national standards and assessments; and have active support within the community.

7. Effective professional development experiences are continuously being assessed and being improved to ensure a positive impact on teacher effectiveness, student learning, leadership, and the school community.

Prior to the late 1990's many professional development experiences brought outside expertise to teachers to increase strictly content knowledge. More recently, research has indicated that these experiences must not only include the teacher but also focus on the school as a whole, and are likely to have a greater impact on practice if tailored to the specific school site. School-site ownership of the professional development agenda that reflects the critical priorities of how each school can maximize student achievement is a necessary ingredient of sustainable improvement in teacher practice. Previously, there has been little direction about how to design professional development so that it promotes continuous learning in the organization, provides equity for teachers and students, builds the capacity of teachers, fits within the school context, and gives teachers the range of experiences they need to learn. Currently, Miami-Dade County Public Schools is implementing the Professional Assessment and Comprehensive Evaluation System (PACES). In PACES, teachers enter into a professional development process with colleague teachers, administrators, and/or district subject area specialists. The results are developed into a personal professional portfolio for review, recommendation and discussion, and therefore produce professional growth. The following design framework organizes the components of effective professional development into a process of planning and action that models the objectives of PACES.



Professional Development Design Process for Mathematics and Science Reform (Adapted from *Designing Professional Development for Teachers of Science and Mathematics* by Susan Loucks-Horsley, et al., 1998)

At the center of the framework is a generic planning sequence incorporating goal setting, planning, doing, and reflecting. Knowledge and beliefs, context, critical issues, and strategies represent important inputs into both goal setting and planning that can help teachers make informed decisions about effective classroom instruction. These

features are at the center of PACES and will become important M-DCPS benchmarks for teacher development.

Research suggests that effective professional development in mathematics and science involves an active study of effective teaching and learning practices. It is important to attend to individual teacher needs and provide learning opportunities. Over time this develops a climate of collegiality combined with a capacity for continuous learning and support. Full implementation of PACES combined with the active school-site support proposed in this plan provides excellent conditions for maximizing teacher effectiveness.

It is intended through *Mathematics and Science Literacy – Bridges to Careers* that all Miami-Dade County public schools implement a *Transformative Learning Model* of professional development at each school site through school-site mathematics and science instructional improvement teams. Educational specialists that are assigned to feeder patterns will facilitate the teams by modeling lessons, deepening content knowledge, and implementing the use of best practices. The Professional Development Design Process illustrated on page 5 will be the vehicle that guides this course of action. This model of professional development is a guide to the implementation of the PACES competencies.

The Professional Development Design Process should be followed by an analysis of the context in which teachers teach their students to learn. Miami-Dade is a culturally diverse community; therefore it is essential that the needs of all M-DCPS students be met. Limited English proficient (LEP) students are expected to master the mathematics and science curriculum at the same pace as other students. Therefore, teachers must have an opportunity to implement effective teaching and learning strategies for LEP students as well as all students with special learning needs. A careful examination of student work provides an opportunity for teachers to understand student thinking so that appropriate instructional strategies and materials can be utilized. Each of these elements is consistent with PACES and will be designed to assist teachers to effectively teach all students. A well-chosen array of experiences for teachers, in many areas of knowledge and skills, within multiple contexts will maximize a teacher's opportunity for professional growth.

A combination of increased mathematics and science course requirements, predicted teacher retirements, and the general attrition of mathematics and science teachers creates a dramatic need for the acquisition of more mathematics and science teachers to staff the classrooms of Miami-Dade County public schools. A master plan to increase the number of certified graduates prepared to teach science and mathematics, in collaboration with the local universities, is necessary and desirable.

The Blueprint - Mathematics and Science Curriculum

CURRENT STATUS

A revised M-DCPS Competency-Based Curriculum (CBC) provides the blueprint for rigorous subject matter content in both mathematics and science. This curriculum integrates National Standards, Florida Sunshine State Standards and Grade Level Expectations for grades K-8, and the objectives from the state course code descriptions for senior high content. There is significant focus on the sequential development of skills and competencies as students progress from grade to grade. Grade-level exit tests have been developed in mathematics for all grades K-8, and an exit examination for Algebra is being explored for use as a district-wide assessment of students completing Algebra I. Using these exit examinations will provide classroom teachers with an annual opportunity to determine student acquisition of grade-level skills and benchmarks.

While the CBC curriculum content includes computation and basic numeric literacy, such as operations, it also emphasizes problem solving, performance tasks, and higher-order thinking, which build real mathematical and scientific power for students. Without such power and the classroom experiences that create it, M-DCPS students will not be able to master the strands of Algebraic Thinking, Geometry and spatial sense, and Statistics/Data Analysis which are assessed on the Florida Comprehensive Assessment Test (FCAT). Students will also need the scientific power to succeed on the Science FCAT as they enter the 2002-2003 school year.

The CBC curriculum is built on a belief that students learn best by doing. Therefore, associated with the revised CBC are published curriculum activities such as: *Here Come the Sunshine State Standards, Awesome Activities for Achieving Success*, *Focus on Algebra I with a Sunshine State Standard Lens, The Elementary SHO-ME Guide,* and *The Mathematics and Science Middle School Curriculum Guides.* These documents were developed to assist teachers in helping students to learn by utilizing problem solving and critical thinking. Textbooks are not the curriculum. Instructional materials are only one tool that contributes to the resources for students to build their capacity to actually do mathematics and science. The Division of USI Mathematics and Science endorses the use of a variety of support materials that enhance student experiences and develop deeper understanding of science and mathematics concepts, especially those that incorporate the effective use of technology.

Miami-Dade County Public Schools offers a full range of mathematics and science curriculum, K-12, that incorporates the needs of limited English proficient (LEP) and Exceptional Student Education (ESE) students, as well as students in the gifted program and those accelerating into the advanced placement courses. Despite increasing enrollment in higher level mathematics and science courses, the Miami-Dade student population as a whole is performing below the state average on the FCAT and

below the national median in mathematics and science as measured by the Stanford-8, except in elementary mathematics.

The Blueprint goals that follow provide the focus for the CBC curriculum that must be in place for M-DCPS students to meet the required benchmarks within science and mathematics. They represent the most important intended outcomes of the District comprehensive plan. These goals should be achieved over the next three years, and sustained as regular occurrences in subsequent years.

GOALS

1. The intended curriculum of the CBC will be fully implemented so that it becomes the "taught" curriculum in all grade levels and in all classrooms.

2. Comprehensive improvement of the District mathematics and science curriculum will be undertaken based on analyses of the TIMSS-R data and the FCAT results.

3. The mathematics and science curriculum will incorporate practical applications of scientific and mathematical concepts connected with a variety of experiences that support school-to-career transition.

The following activities will provide the structure necessary to ensure that the content and pedagogy for mathematics and science literacy are in place within all District schools.

Action Plan

1. Structured staff development through the mathematics and science instructional improvement teams will be implemented at each school site. The content standards that are expected at each grade level and in all secondary mathematics and science courses will be communicated to all schools. Extensive support materials will be produced and disseminated for this effort.
2. Feeder pattern educational specialists and/or expert teacher leaders in mathematics and science will provide schools professional development opportunities one day per week. Florida State University graduates, Eisenhower Resource Teachers and Title I Mathematics Specialists will provide on-going support to all District schools to improve the quality and the delivery of the curriculum.
3. Teams of mathematics and science content specialists and specialists in data analysis/evaluation will conduct comprehensive analyses of the data from the Third International Mathematics and Science Study-Repeat (TIMSS-R) and the FCAT. These analyses will determine weaknesses in curriculum content, pedagogy and the sequence of topics covered.

4. The TIMSS Study Center at Michigan State University will conduct additional analyses in conjunction with district staff.

5. Curriculum writing teams will refine curriculum content, depth of content coverage, pedagogy and the sequence of topics covered in response to the analyses of data mentioned in items 3 and 4.

6. Focus groups that represent the targeted industries of One Community One Goal® will be established in order to provide input on curriculum revisions in mathematics and science.

7. The infusion of practical, real-world applications of mathematics and science and school-to-career objectives will be a priority at all grade levels.

8. District-developed assessments will be redesigned to assist schools in monitoring student acquisition of Florida Grade Level Expectations (GLE's) for grades K-8 and an exit examination for Algebra I will be developed.

9. The American College Testing (ACT) Work Keys evaluation of student work-skill levels among senior high school students will be utilized to target specific areas of focus in the curriculum in order to enhance preparation for high-skilled jobs in the local and state economy.

10. High quality, content-rich and interactive software will be provided to promote accelerated student learning and the effective use of technology in mathematics and science classrooms, particularly at the middle school and senior high school levels.

11. The use of standards-based and research-based curricula programs in mathematics and science, such as, *Mathematics in Context, Core Plus, Full Option Science System (FOSS), Science and Technology for Children (STC), and Active Physics* will be expanded.

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The Foundation – The Elementary Program

CURRENT STATUS

During the five years M-DCPS has participated in the National Science Foundation's Urban Systemic Initiative (USI) in Mathematics and Science, elementary teachers received massive training in the pedagogy of mathematics and science. As a result of this training, there has been an increase in the planning and instruction of mathematics and science curriculum at the elementary level. However, there still remains a need for elementary teachers to strengthen their content knowledge in order to effectively address the instruction of state and national standards in mathematics and science.

There is statistical evidence of a steady increase in student scores on the Stanford-8 subtest in Science and Mathematics Applications, as well as the FCAT mathematics. While these results are promising, M-DCPS students are still not meeting the very challenging state, national, and international standards.

The elementary school programs in mathematics and science provide the necessary, solid foundation for the educational bridge to careers. As a foundation, students obtain crucial requisite skills as they progress from each grade level, K - 5. Literacy in mathematics requires that M-DCPS students receive instruction in all five mathematics strands at each grade level: Number Sense, Concepts and Operations; Measurement; Geometry and Spatial Sense; Algebraic Thinking; and Data Analysis and Probability. Literacy in science requires instruction at each grade level on all eight strands in science: Nature of Matter; Energy; Force and Motion; Processes That Shape the Earth; Earth and Space; Processes of Life; How Living Things Interact with their Environment; and the Nature of Science.

Of equal importance in building the foundation, M-DCPS students need richer educational experiences at each grade level in which they investigate, question, discuss and verify their work in mathematics and science. Such academic experiences begin with practical inquiry about the world in which the students live and the relationships that mathematics and science explain.

In maintaining the efforts in mathematics and science reform in elementary classrooms through the Urban Systemic Initiative, this District Plan, *Mathematics and Science Literacy – Bridges to Careers,* provides a framework for assistance to elementary schools in sustaining the efforts brought about by the reform.

The following goals represent the most important intended outcomes for the elementary program of this District comprehensive plan. These goals should be achieved over the next three years, and sustained as regular occurrences in subsequent years.

GOALS

1. All elementary school sites will develop and implement a mathematics and science instructional improvement team.

2. All feeder patterns will develop and implement feeder pattern support teams in mathematics and science.

3. All students, including those with special learning needs such as LEP and standard curriculum ESE students in grades K-5, will demonstrate performance consistent with the Florida GLE's in mathematics and science.

4. All students will increase their level of mathematics and science literacy, problem solving ability, and ability to communicate their conceptual knowledge of mathematics and science.

5. All elementary teachers will increase their content knowledge and attain a comfort level with the delivery of the concepts of the five mathematics strands and the eight science strands.

6. Elementary feeder pattern educational specialists will disseminate information to parents within the community regarding how the local, state, national and international standards in mathematics and science have increased. This will provide the information for parents to assist their elementary school students with achieving these standards.

7. After-School Care Programs will include structured academic experiences with mathematics and science concepts.

8. All elementary principals and assistant principals will receive professional development designed to support mathematics and science instruction at their school. This support will assist elementary principals and assistant principals in the promotion of mathematics and science careers, and in the improvement of the quality of programs offered at the school site.

9. Instruction and materials that support career awareness in the areas of mathematics and science should be emphasized through schoolwide programs, such as Career Days, mathematics and science clubs, Science, Engineering, Communication, Mathematics Enhancement (SECME) Programs, Kids and the Power of Work (KAPOW), and Career-Shadowing experiences.

The following activities will provide the structure for the development and implementation of a rigorous and sustainable elementary school program across the district.

ACTION PLAN

1. Elementary feeder pattern educational specialists will be assigned and be responsible for facilitating the mathematics and science instructional improvement team at each respective site.

2. Every elementary school will develop a mathematics and science instructional improvement team consisting of at least one representative from each grade level, in order to implement the *Transformative Learning Model* for professional development.

3. Elementary experts who are recent graduates of the M-DCPS/FSU graduate program for mathematics and science will assist specific elementary schools with subject area content on a regular basis. (e.g., Wednesday afternoons, teacher work days and Saturdays).

4. Eisenhower Resource Teachers and Title I Mathematics Specialists will provide content-rich support to school-site teams.

5. District staff from the Division of USI Mathematics and Science and the feeder pattern educational specialists will assist with the development of individual Professional Development Plans for teachers as required by state statute (Sections 231.085; 231.09; 231.29, F.S.).

6. All elementary teachers in M-DCPS will teach a sixty-minute block of mathematics and a thirty-minute block of science daily, or teachers may combine an integrated mathematics and science content into a ninety-minute block.

7. All elementary teachers will deliver nine lessons on each of the five mathematics strands during each nine-week grading period. This will include a spiral of the strands, with an increased intensity of instruction in each consecutive nine-week cycle.

8. All teachers must incorporate effective teaching strategies for mathematics and science, including *Creating Independence through Student-owned Strategies* (CRISS) for mathematics and science and the Reciprocal Teaching Model. These strategies are found in the Science and Mathematics Integrated with Learning Experiences (SMILE) workshops provided by the Eisenhower Professional Development staff.

9. Teachers will utilize the district-produced pretests and posttests and additional assessment instruments to assess student learning and attainment of the Florida GLE's.

10. All elementary science teachers will utilize kit-based instruction wherever possible. FOSS and Science and Technology for Children (STC) kits provide extensive use of hands-on, inquiry-based science.

11. A research-based mathematics program with a proven record of success in urban districts will be explored for use in elementary schools. Everyday Mathematics is a NSF-endorsed program suitable for implementation. Project MIND, a pilot mathematics project, will be utilized in several schools to enhance foundation skills in mathematics. Annenberg funding will be available for this project. *Mathematics in Context (MIC)* will be utilized in Grade 5.

12. All grade four and five science programs will continue to implement SCI-TV.

13. Each school will provide one Family Math/Family Science Night per semester, to inform the community and parents about the instructional practices, curriculum, and assessments that are currently being used in mathematics and science classrooms.

14. Feeder pattern educational specialists will plan and implement community information meetings for every school within the district, to inform parents and the community about the Third International Mathematics and Science Study-Repeat (TIMSS-R) data, and implications to improve student achievement on the FCAT.

15. Elementary teachers will incorporate hands-on SECME engineering/career-type activities in their classrooms, and increase participation in District-sponsored SECME events.

EXPECTED STUDENT OUTCOMES

Elementary Mathematics-Exiting Grade 5

Elementary mathematics should build on children's curiosity and grow naturally from their experiences. Mathematical experiences for children, if appropriately connected to the real world, challenge young children to apply ideas that include quantitative relationships, geometry and spatial sense, number sense and interpretation of data. These experiences will promote conceptual understanding within each strand of the Sunshine State Standards. Understanding mathematical ideas can stimulate and support the acquisition of skills as well as the ability to solve problems.

A. Number Sense, Concepts and Operations

The foundation of literacy in mathematics begins with this strand – the ability to understand numbers and basic operations with numbers. An important goal of mathematics instruction is to develop students' ability to reason intelligently with quantitative information.

Students should be able to:

- Use their knowledge of numbers in flexible ways, in addition to routine, predictable calculations. Estimation should become an integral part of the students' mathematical skills in order to solve a variety of problems.
- Understand numbers and the relationships among the operations of addition, subtraction, multiplication, and division; select appropriate operations; and compute to solve problems.
- Use basic calculator functions as a part of the program beginning with grade 2 or 3.

B. Measurement

Students must develop their understanding of measurement and systems of measurement through experiences which enable them to use a variety of techniques, tools, and units of measurement. These experiences should include both the standard and metric system.

Students should be able to:

- Estimate and measure quantities in the real world.
- Compare, contrast, and convert within systems of measurement (both standard/nonstandard, and metric).
- Connect measurement with geometry and spatial sense (e.g., units of volume), and data analysis (e.g., units of measurement on graphs).
- Develop understanding and explore the study of length, area, and volume in 2 and 3 dimensional shapes.

C. Geometry and Spatial Sense

Students' knowledge of geometry and spatial sense should be developed through the use of rich, hands-on geometric experiences. These experiences will enable students to improve their spatial sense.

Students should be able to:

- Visualize and illustrate ways in which shapes can be combined, subdivided and changed, using their understanding of congruency, similarity and symmetry.
- Use coordinate geometry to locate objects in two dimensions.
- Determine horizontal and vertical distances.
- Develop the concepts of length, perimeter, area, radius, line segments, angles, volume and their interrelationships.

- Develop their communication skills and make connections between geometry and other branches of mathematics as well as other subjects.
- Develop a mathematics vocabulary, similar to the glossary found in *The Florida Curriculum Frameworks for Mathematics.*

D. Algebraic Thinking

Students must experience progressively more complex opportunities to solve problems involving patterns that can be expressed algebraically and which require critical thinking.

Students should be able to:
- Identify patterns in the world around them.
- Create, describe, analyze, and generalize a wide variety of patterns, relations and functions.
- Use expressions, equations, inequalities, graphs and formulas to represent and interpret situations.

E. Data Analysis and Probability

Probability and statistics permeate almost all disciplines and their study allows students to make sense of their experiences in a wide variety of ways.

***Students should be able to*:**
- Collect, organize, and display data sets, using appropriate graphs, (e.g., pictograph, circle graph, single and double bar graph, and line graph).
- Identify patterns and make predictions from an orderly display of data using concepts of probability and statistics.
- Use statistical methods to make inferences and valid arguments about the real world.

Elementary Science-Exiting Grade 5

A significant focus of the elementary science program is to create the foundation for true inquiry. Actual classroom practices must provide students with opportunities to engage in inquiry and to develop the habits of mind that are necessary to engage students in the scientific process. These include: questioning, planning, conducting investigations, thinking critically about the relationships between evidence and explanations, predicting and analyzing alternative explanations.

The use of accurate measurement techniques must be taught at each grade level for students to progress in their capacity to demonstrate measurement and to use tools to illustrate measurement. Effective use of science kits in every classroom extends educational experiences beyond textbook learning and provides students with opportunities to learn by doing science. Inquiry-based activities allow students actual engagement in the science process skills of classifying, communicating, predicting,

modeling, investigating and hypothesizing. The overall science goal of the K-5 foundation is to provide students with an integration of progressively more complex content knowledge within the science strands and practical problem-solving experiences in which scientific principles are effectively applied.

A. The Nature of Matter

Through observation, comparison, and classification, students can learn the basic properties and characteristics of matter and begin to see the role of matter in the everyday world. Substances differ greatly in mass, volume, shape, density, texture, reaction to temperature and light and in many other ways. Most substances exist in different states or phases.

Students should be able to:

- Describe observable and measurable properties of matter, understand concepts of matter, such as occupying space, having mass and the nature of the states of matter:
- Demonstrate how matter undergoes changes both physical and chemical.
- Knows that different materials are made by physically and chemically combining two or more substances.
- Demonstrate the use of metric tools to calculate the density and measure volume.

B. Energy

Energy is an abstract but fundamental concept in science. Learning about energy is essential to understanding changes observed in natural and human-made systems. Nearly all energy on Earth comes from the sun. Energy exists in many forms such as motion, heat, light, electricity, and sound. Although these forms are different they can be changed from one form to another. Plants use light energy in the food making called photosynthesis. Food is a source of stored energy that can be used to do work such as keeping human body temperature constant, producing body movement, and thinking. Electrical energy is used to run machines and appliances and produce light. Earth's supplies of usable energy sources like coal and oil is limited.

Students should be able to:

- Understand how energy and matter interact, and how models can be used to illustrate how energy flows through a system.
- Understand how model energy systems change throughout the year.
- Identify different heat sources such as friction, solar, nuclear and electric.
- Understand the relationship of food to the need for daily energy intake.
- Participate in real-life energy-related investigations.

C. Force and Motion

Force and motion are essential components of the physical and biological world. The relationship between forces of objects is central to understanding different types of movement that occur in the universe. Force explains starting, stopping, changing direction, floating, falling, and many other types of motion-related phenomena.

Students should be able to:
- Know the amount and direction of the force exerted on an object.
- Know mathematical relationship between force and mass.
- Identify simple and complex machines.
- Make comparisons between potential and kinetic energy.
- Demonstrate that sound travels differently through different media.

D. Processes that Shape the Earth

The physical laws that have governed the entire universe in the past are the same ones that govern material interactions today. Understanding and applying these laws to geological processes provides insight into how Earth formed, how it has evolved, and how it continues to change.

Students should be able to:
- Know that the surface of the Earth is composed of different types of solid materials that are defined in categories such as minerals and rocks.
- Understand the process of erosion.
- Understand temperature pressure and that the topography of the land influences the water cycle.
- Understand that geological features result from the movement of the crust of the Earth.
- Know how organisms adapt in order to survive within their given habitats.
- Recognize that human activity affects the global environment.

E. Earth and Space

The interaction and organization of matter and energy in the solar system and the universe is central to an understanding of earth and space. The organization of the solar system, the galaxy, and the universe is fundamental to the study of Earth and Space Science.

Students should be able to:
- Describe orbital movements such as rotation and revolution.
- Classify planets by their properties.
- Understand celestial phenomena.
- Understand the cycles of the moon and the effect of the moon's orbit on the Earth.

F. Processes of Life

A fundamental goal of the biological sciences is to understand the essential processes of life on earth. Central to an understanding of these processes are the patterns of structure and function in living things. By examining the characteristics of organisms, animals and plants can be associated with their environment, e.g., algae and pond, cactus and desert.

Students should be able to:

- Understand how body systems interact and are related.
- Understand that similar cells form different kinds of structures.
- Know the relationship between animals and plants.
- Understand that many characteristics of an organism are inherited from the ancestors of that organism.
- Know that some characteristics result from the organism's interactions with the environment.

G. How Living Things Interact with Their Environment

Living things depend upon one another and their environment. Specific relationships exist among organisms: the kinds of physical conditions that organisms must endure, the kinds of environments created by the interaction of organisms with one another, and with their physical surroundings.

Students should be able to:

- Explain the interdependence of plants and animals as shown in food chains and food webs.
- Understand the concept of adaptation of organisms to their environment.
- Know that all living things must compete for limited resources.

H. The Nature of Science

Students should recognize that science, technology, and society are interwoven and interdependent. Collecting things, designing and conducting simple experiments, making predictions, asking questions about their observations, classifying things, and observation, making generalizations, and discussing their findings with peers are among typical behaviors. Science is related to real-world issues. It requires a thoughtful critique of all aspects of investigations, as well as extensive opportunities for setting up, executing, and designing investigations to answer questions.

Students should be able to:

- Plan and conduct simple experiments that include the process skills of observing, classifying, communicating, questioning, measuring, predicting, collecting and recording data, making models, investigating, experimenting, identifying and controlling variables, hypothesizing, interpreting data and inferring.
- Understand that the solutions to one scientific problem can create another problem.
- Construct models to compare objects in science.
- Understand the importance of communication among scientists.

The Scaffolding – The Middle School Program

CURRENT STATUS

The goal of mathematics and science curriculum in the middle grades is to provide a solid background for senior high school and beyond – post-secondary education and/or the world of work. M-DCPS' CBC for middle school mathematics provides detailed content maps for each grade level on all five strands in mathematics, delineating this necessary groundwork. The CBC for middle school science provides content and experiences in the eight science strands. Repetitive review of the elementary content in mathematics and science, or modified re-teaching of grade 6 content at grade 7 or 8, will not provide the knowledge, skills, and experiences necessary for senior high school work. Telling middle school students how to perform a particular procedure without giving it a personal context and then requiring them to sit quietly by themselves to practice the procedure goes against their very nature. Support materials for classroom use, such as *Here Come the Sunshine State Standards, Awesome Activities for Achieving Success* and *Focus on Algebra I with a Sunshine State Standard Lens,* encourage student engagement in the learning process. These resources are currently available, but seldom implemented in today's middle school mathematics and science classrooms. The typical practice in middle school classrooms does not provide contextual learning experiences that connect to real-life applications and problem solving. The performance of M-DCPS middle school students on standardized tests such as the Stanford-8 and FCAT has not shown the steady increases realized at the elementary level.

A recent study released by the Council of Chief State School Officers entitled *State Indicators of Science and Mathematics Education 1999* reported that nationally at the eighth grade level, 23 percent of students scored at or above proficient level in the 1996 National Assessment of Educational Progress in Mathematics. Florida had 17 percent of its students scoring at or above proficient level. The scores of minorities were especially low in Florida when compared to white non-hispanic students at the eighth grade level. Florida was tied for second place for states having the greatest disparity between white non-hispanic and minority students scoring at or above the basic level. Such results pointedly illustrate the urgent need for dramatic and different approaches with middle school learners.

M-DCPS' Office of Instructional Technology has been involved in a federal grant entitled, Alliance +. Through this grant teachers from thirty middle schools have received level I and level II training in the use of real-time Internet data for mathematics and science, with the help of the Steven's Institute.

The following goals represent the most important intended middle school outcomes of this district comprehensive plan. These goals should be achieved over the next three years, and sustained as regular occurrences in subsequent years.

GOALS

1. All middle school sites will develop and implement a mathematics and science instructional improvement team.

2. All feeder patterns will develop and implement feeder pattern support teams in mathematics and science.

3. All students, including LEP and standard curriculum ESE students, in grades 6-8 will demonstrate performance consistent with the Florida GLE's in mathematics and science.

4. All students will increase their level of mathematics and science literacy, problem-solving ability, and ability to communicate their conceptual knowledge of mathematics and science.

5. All middle school science and mathematics teachers will increase their pedagogical and content knowledge of the five mathematics strands and the eight science strands.

6. Secondary feeder pattern educational specialists will disseminate information to parents within the community regarding how the local, state, national and international standards in mathematics and science have increased. This will provide information for parents to assist their middle school students with achieving these standards.

7. All middle school mathematics and science teachers will increase the use of appropriate technology within the classroom and increase the proficiency of students' use of technology as it assists with problem solving.

8. All middle school principals and assistant principals will receive professional development designed to support mathematics and science instruction at their school. This support will assist principals and assistant principals in the promotion of mathematics and science careers, and improve the quality of programs offered at the school site.

9. Instruction and materials that support career awareness in the areas of mathematics and science will be emphasized through schoolwide programs, such as Career Days, mathematics and science clubs, SECME Program, and Career Shadowing experiences.

The following activities will provide the structure for the development and implementation of a rigorous and sustainable middle school program across the district.

ACTION PLAN

1. Secondary feeder pattern educational specialists will be assigned and be responsible for facilitating the mathematics and science instructional improvement team at each respective middle school site.

2. Every middle school will develop a mathematics and science instructional improvement team consisting of two representatives from each grade level, one in mathematics and one in science, which also includes department chairpersons and an administrator, in order to implement the Transformative Learning Model for professional development. This process will facilitate teacher collaboration on the integration of mathematics and science content, effective pedagogy, and appropriate assessment practices.

3. National Board-certified mathematics and science teachers and Title I mathematics specialists will provide content-rich support on a regular basis during early release days, teacher work days and Saturdays to continue staff development efforts.

4. District staff from the Division of Mathematics and Science and the secondary feeder pattern educational specialists will assist with the development of professional development plans for teachers in mathematics and science.

5. All middle school science and mathematics teachers will teach the prescribed content and benchmark skills that are in the middle school curriculum.

6. All mathematics teachers will deliver nine lessons on each of the five mathematics strands during each nine-week grading period. This includes a spiral of the strands, with an increased intensity of instruction in each consecutive nine-week cycle.

7. All science teachers will utilize two lessons a week for laboratory activities that build conceptual development of science principles and their application to problem solving.

8. All teachers will incorporate effective teaching strategies for mathematics and science, including CRISS strategies for mathematics and science and the use of the Alliance + technology modules for mathematics and science.

9. Teachers will utilize the district-produced pretest, posttest and additional assessment instruments to assess student learning and attainment of the Florida GLE's.

10. Research-based programs in mathematics and science with a proven record of success in the areas of curriculum connections and student achievement, such as Math In Context (MIC) and the Jason Project, will be incorporated into the middle school program.

11. Each school will provide one Family Math/Family Science Night per semester, to inform the community and parents about the instructional practices, curriculum, and assessments that are currently being used in mathematics and science classrooms.

12 Secondary feeder pattern educational specialists will plan and implement community information meetings for every school within the district, to inform parents and the community about the Third International Mathematics and Science Study Replication (TIMSS-R) data, and implications to improve student achievement on the FCAT.

13 Expansion of the SECME-Rise project, which targets minority female students to build awareness and interest in mathematics, science and engineering careers will take place. There will be an increase in the number of field trips to engineering sites for middle school students to observe mathematics, science, technology and engineering being used in the real world and increase participation in District-sponsored SECME events.

14. The efforts of the INSTAR program, a summer institute held in conjunction with the University of Miami, will be sustained. University collaborative programs such as the Partnership with Academic Communities (PAC) at Florida International University will be extended and enhanced to enrich teacher and student experiences with mathematics.

15. Extending and enhancing the Florida Atlantic University collaborative program, the summer Fractals Institute, designed to enrich teacher and student experiences with mathematics and technology.

16. Mentoring programs with local private sector/business partners for potential career interests will be initiated.

17. The Superintendent's Summer Academy for Mathematics will be implemented, at the conclusion of grades 6, 7, and 8, targeting 100 students, including LEP and standard curriculum ESE students, at each middle school for intensive instruction on algebraic thinking, measurement, and geometry and spatial sense.

EXPECTED STUDENT OUTCOMES

Middle School Mathematics-Exiting Grade 8

Expected Student Outcomes

M-DCPS' CBC supplement in Mathematics grades 6, 7 and 8 provides detailed content maps for each grade level on all five strands in mathematics. The content includes all of the Florida Grade Level Expectations and the benchmarks tested on the grade 8 FCAT.

Teachers must teach the prescribed content using pedagogy appropriate for this age group. Repetitive review of the elementary content in mathematics and science, or modified re-teaching of grade 6 content at grade 7 or 8, will not provide the knowledge, skills, and experiences necessary for senior high school work. Intensive staff development work with teachers is needed to produce a shift in current teaching patterns in the middle school.

A. Number Sense Concepts and Operations

During grades 6-8, student understanding of systems of numbers should be enhanced. Mathematics instructional programs should foster the development of number and operation sense so that all students are able to reason intelligently with quantitative information.

Students should be able to:

- Demonstrate an understanding of and apply properties and relationships of whole numbers, fractions, decimals, percents, integers, rational and irrational, radicals, numbers with exponents, numbers expressed in scientific notation, absolute values.
- Solve real-world problems using these numbers and their relationships and involving exact answers and/or estimation and approximation, using mental mathematics, calculators, or any other type of technology, as appropriate.

B. Measurement

The notion of measurement includes the real-number line, the rectangular coordinate system and the polar coordinate system. Students understanding of measurement will enable them to both estimate and solve real-world problems.

Students should be able to:

- Estimate and measure quantities in real-world situations, compare and apply relationships of measurements and scales, and derive measurement formulas for surface area and volume of regular three-dimensional shapes.
- Explore and derive formulas for rates, distance, time, and angle measurements, and apply these formulas in problem solving.

- Solve real-world problems involving a variety of measurement situations (length, area, volume or capacity, time, mass/weight), and convert measurement units when necessary.

C. Geometry and Spatial Sense

The classes of objects that form the core of middle school geometry and spatial sense (lines, angles, polygons, circle, and a variety of two-dimensional objects) are much the same as in previous grades. Geometry learning in grades 6-8 should focus on the relationships among these objects. The study of geometry and spatial sense provides a means of describing, analyzing, viewing, and understanding the physical world and seeing the beauty in its structure.

Students should be able to:
- Understand and apply the properties and relationships of geometric shapes.
- Understand, predict and utilize characteristics of patterns in two- and three-dimensional situations.
- Solve real-world problems involving these properties and relationships, including concepts of parallel and perpendicular lines, slopes, transformations, congruency and symmetry, angle and triangle relationships (e.g., The Pythagorean Theorem).

D. Algebraic Thinking

Students should have a balanced understanding of patterns and functions. This includes an understanding of the forms and properties of a broad array of functions and the ability to use these forms and properties to solve problems in a wide range of contexts.

Students should be able to:
- Understand the use of variables and the concept of functions, evaluate and simplify expressions, solve equations, and translate verbal expressions into algebraic symbols.
- Understand and apply properties and relationships of first degree equations and inequalities and their graphs in the context of problem solving.
- Use calculators and technology to solve problems, display data, and explain graphs.

E. Data Analysis and Probability

Students in grades 6-8 build on previous experiences with various ways of displaying data, so that their knowledge can become more formal and can be used to make comparisons. Students should learn what is involved in using surveys, experimental design, and sampling techniques.

Students should be able to:
- Understand and display data in tables, graphs and charts.

- Interpret and compare data, making predictions and conclusions in a problem-solving context.
- Use calculators and technology when appropriate.
- Determine probabilities and odds of events in a real-world context.

Middle School Science-Exiting Grade 8

The instructional activities of a scientific inquiry should involve students in establishing and refining the methods, materials, and data they will collect. As students conduct investigations and make observations, they should consider questions such as "What data will answer the question?" and "What are the best observations or measurements to make?" Students should be encouraged to repeat data-collection procedures and to share data among groups.

In middle schools, students produce oral or written reports that present the results of their inquiries. Such reports and discussions should be a frequent occurrence in science programs. Students' discussions should center on questions, such as "How should we organize the data to present the clearest answer to our question?" or "How should we organize the evidence to present the strongest explanation?" Out of the discussions about the range of ideas, the background knowledge claims, and the data, the opportunity arises for learners to shape their experiences about the practice of science and the rules of scientific thinking and knowing.

The language and practices evident in the classroom are an important element of doing inquiries. Students need opportunities to present their abilities and understanding and to use the knowledge and language of science to communicate scientific explanations and ideas. Writing, labeling drawings, completing concept maps, developing spreadsheets, and designing computer graphics should be a part of the science education.

A. The Nature of Matter

Substances differ greatly in mass, volume, shape, density, texture, reaction to temperature and light and in many other ways. Most substances exist in different states or phases. Changes from one phase of matter to another involve a gain or loss of energy. If the temperature of a substance is increased, its atoms or molecules tend to move further apart. Elements contain only one kind of atom. Other substances are made up of two or more different elements in which the atoms group together to form molecules. Substances can undergo physical changes that only alter the shape, form, volume, or density of the material but produce no change in chemical composition. Physical changes do not bring about the alterations in the properties of matter that chemical changes do.

Students should be able to:

- Identify various ways in which substances differ (e.g., mass, volume, shape, density, texture, and reaction to temperature and light).
- Describe how the atoms in solids are close together and do not move around easily; in liquids, atoms tend to move farther apart; in gas, atoms are quite far apart and move around freely.
- Investigate the difference between a physical change in a substance (e.g., altering the shape, form, volume, or density) and a chemical change (e.g., producing new substances with different characteristics).
- Describe the general properties of the atom and accept that single atoms are not visible.
- Chemically combine new substances to produce new substances different from the original reactants.
- Relate physical and chemical change to events such as: the water cycles, the carbon cycle, and plant growth.

B. Energy

Energy comes to the earth from the sun, both as visible light and as other forms of electromagnetic radiation, such as infrared and microwave. Most of the energy used today is derived from burning stored energy collected by organisms millions of years ago – non-renewable fossil fuels. Energy exists in many forms and is classified in several ways: mechanical (potential and kinetic), chemical, electrical, magnetic, nuclear, and radiant. The amount of energy in a closed system always remains the same. However, when one form of energy changes to another form, the amount of energy in the original form decreases while the amount of energy in the new form increases. Most of what goes on in the universe involves some form of energy being transformed into another.

Students should be able to:

- Design and perform experiments to show energy exists in many forms and how energy may be used to do work.
- Identify forms of energy and explain how they can be measured and compared.
- Know that energy cannot be created or destroyed, but only changed from one form to another.
- Know the properties of waves (e.g., frequency, wavelength, and amplitude); that each wave consists of a number of crests and troughs; and the effects of different media on waves.
- Understand that most of the energy used today is derived from burning stored energy collected by organisms millions of years ago (i.e., nonrenewable fossil fuels).

C. Force and Motion

Forces have both magnitude (size) and direction. Often, more than one form acts on an object at the same time. The overall effects of these forces are called net force. Among

the common examples of important contact forces are friction, buoyancy, lift, and force exerted by the wind or water. Unbalanced forces produce a change in the motion of the objects on which they act, while balanced forces do not alter the motion on which they act. Simple machines can be used to change the direction or size of a force. Mass remains constant in the universe whereas weight changes from place to place. Some motions keep recurring. These recurring motions lend themselves to measuring time.

Students should be able to:

- Distinguish the characteristics of a body by its position, direction of motion, and speed.
- Diagram models that portray how different type forces (e.g., gravitational, electrical, and magnetic) act at a distance (i.e., without contact) and some act with contact.
- Understand that simple machines can be used to change the direction or size of a force.
- Know that gravity is a universal force that every mass exerts on every other mass.

D. Processes that Shape the Earth

Earth is a unique planet with four major interacting systems: lithosphere (earth), atmosphere (air), hydrosphere (water), and biosphere (life). Conditions that exist in one system influence the conditions that exist in the other system. Sediments of sand and shell of dead organisms may become buried and embedded in their substrates where, in time, they may be subject to great pressure from the weight of materials above. These layers of sedimentary rocks give clues to the age and history of Earth and provide evidence of changing life forms the remains of which are found in successive layers. Understanding the concept of time and size is critical when exploring interacting Earth processes.

Students should be able to:

- Analyze how mechanical and chemical activity 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.
- Characterize how conditions that exist in one system influence the conditions that exist in other systems.
- Know the ways in which plants and animals reshape the landscape (e.g., bacteria, fungi, worms, rodents, and other organisms add organic matter to the soil; therefore increasing soil fertility, encouraging plant growth, and strengthening resistance to erosion).
- List and describe the consequences of human actions on the Earth's systems.
- Participate in school/community efforts to conserve, and or recycle community resources.

E. Earth and Space

The concept of size of the Solar System is important to understanding the relationship of the planets to one another and to the Sun. Nine known planets orbit the Sun in the Solar System. They vary greatly in size, composition, and characteristics. Many have moons and many have rings of rock and/or ice particles, debris, and gas. Land features and the moons of other planets show evidence of earthquakes, weathering, erosion, and volcanic activity similar to those found on Earth. Light from the Sun reaches Earth in a few minutes, yet some stars are so far away that their light takes several billion years to reach Earth. Stars appear to be made up of the same chemical elements as the Sun. The distance from the Sun allows sufficient light to reach the Earth and sustain life.

Students should be able to:

- Understand the vast size of the Solar System and the relationship of the planets and their satellites.
- Determine, by examining the available data from various satellite probes, the similarities and differences among planets and their moons in the Solar System.
- Know that stars appear to be made of similar chemical elements, although they differ in age, size, temperature, and distance.
- Know that thousands of other galaxies appear to have the same elements, forces, and forms of energy found in the Solar System.

F. Processes of Life

Biological sciences strive to understand the essential processes of life on Earth. Central to an understanding of these processes are the patterns of structure and function in living things. The structures of other living things will be examined in terms of their form and function and integrated to describe the essential processes for their survival on Earth.

Students should be able to:

- Understand that living things are composed of major systems that function in reproduction, growth, maintenance, and regulation.
- Determine through analysis the structural basis of most organisms is the cell and most organisms are single cells, while some, including humans, are multicellular.
- Describe the levels of structural organization for functions in living things include cells, tissues, organs, systems, and organisms.
- Design a model that demonstrates the understanding that cells with similar functions have similar structures, whereas those with different structures have different functions.
- Explain that behavior is a response to the environment and influences growth, development, maintenance, and reproduction.
- Know that the variation in each species is due to the exchange and interaction of genetic information as it is passed from parent to offspring.

- Know that the fossil record provides evidence that changes in the kinds of plants and animals in the environment have been occurring over time.
- Design a model to demonstrate the correlation between healthful living and human body system maintenance.

G. How Living Things Interact with Their Environment

Food webs offer examples of species drawing their mineral and energy needs from other species. Attention is drawn to the transfer of energy from one organism to the next. A central concept is that life is maintained by the continuous input of energy from the sun and by the recycling of the atoms that make up the molecules of living organisms: carbon, oxygen, hydrogen, nitrogen, phosphorous, calcium, potassium, and others. Variation in light, water, temperature, and soil content are largely responsible for the existence of different kind of organisms and population densities in an ecosystem*.*

Students should be able to:
- Design a model that describes how viruses depend on other living things.
- Know that biological adaptations include changes in structures, behaviors, or physiology that enhance reproductive success in a particular environment.
- Understand that the classification of living things is based on a given set of criteria and is a tool for understanding biodiversity and interrelationships.
- Apply the understanding that some resources in your local community are renewable and others are non-renewable.
- Construct a model that displays how biotic and abiotic factors are interrelated and that if one factor is changed or removed, it impacts the availability of other resources within the system.
- Understand that humans are a part of an ecosystem and their activities may deliberately or inadvertently alter the equilibrium in ecosystems.

H. The Nature of Science

Researching and analyzing historical and current discoveries of scientists can provide information about the inquiry process and its effects. Using their intellect and aided by instruments that extend the senses, scientists can discover patterns in nature. Scientific tools such as microscopes, balances, and other instruments facilitate inquiry and problem-solving strategies.

Students should be able to:
- Know that scientific knowledge is subject to modification as new information challenges prevailing theories and as a new theory leads to looking at old observations in a new way.
- Know that accurate record keeping, openness, and replication are essential to maintaining an investigator's credibility with other scientists and society.
- Design an investigation that demonstrates how a change in one or more variables may alter the outcome of an investigation.

- Recognize the scientific contributions that are made by individuals of diverse backgrounds, interests, talents, and motivations.
- Understand that contributions to the advancement of science, mathematics, and technology have been made by different kinds of people, in different cultures, at different times and are an intrinsic part of the development of human culture.
- Know that computers speed up and extend people's ability to locate, collect, sort and analyze data; display via various media, prepare research reports, and share data and ideas with others.

The Superstructure – The Senior High School Program

CURRENT STATUS:

The superstructure of Miami-Dade's Bridge to Careers is the senior high school program. The courses of study in both mathematics and science are content-laden, and include important and even crucial concepts and principles which students must be able to use to solve problems in the workplace. Graduation requirements for senior high school students in 2000-2001 will include Algebra I, Geometry (for the incoming class of ninth grade), and one additional Level II course. In science, students will take Earth/Space Science, Biology and Chemistry (or Physical Science).

Student performance in mathematics, as measured through the FCAT grade 10, in 1999, showed that 38% of the student standard curriculum population of Miami-Dade County Public Schools scored at the lowest level, level I. This level indicates little success with the challenging content of the Sunshine State Standards. Twenty-eight percent of the tenth grade students scored at level 2, which indicates limited success.

Employers throughout South Florida, and throughout the country, are sounding a clear and distinct alarm bell that students who are seeking employment cannot apply mathematics or science concepts in the workplace context. Therefore, while Miami-Dade's public high schools must redouble their efforts to teach the concepts and content of Algebra and Biology, Chemistry and Geometry, it must be done with a different focus. That focus must be on a deeper understanding of the concepts coupled with the practical application of those concepts in solving everyday problems.

However, to achieve the level of mathematics, science and technology literacy necessary to successfully meet the workforce development needs, a substantial and significant shift must occur. An emphasis on the practical use of mathematics, science and technology as applied in the workplace, and on the collective educational experiences that enhance student capacity to do so, must be incorporated into the curriculum.

Combining solid theoretical and conceptual development in senior high mathematics and science with practical applications of the concepts in solving problems will be the focus of Miami-Dade Public Schools' program at the senior high level. A system-wide effort of this type will be integrated with the district's school-to-career initiatives, One Community One Goal® efforts, and the overall district strategy for transforming the senior high schools through the implementation of the career academy model.

Transforming instructional practices at the senior high school level has been a persistent issue for educational reform throughout the country. Locally M-DCPS is engaged in some important efforts to address this issue in a substantive and pervasive manner. These include the following: establishing academies within high schools for career preparation and curricular focus, Tech-Prep programs/academies, High Schools

That Work initiative, Theme-focused magnet schools K-12 School-To-Career program, and the One Community One Goal® initiative.

Transformation should be aided and accelerated by extensive use of research-based programs with documented success such as: Core-Plus Mathematics, Discovering Geometry, Pacesetter, Chem Com, and Active Physics. The extended use of technology-based software such as The Cognitive Tutor Algebra Program, River Deep Algebra, Geometry Sketch Pad, graphing calculators, calculator-based laboratories and probes, and Video-Discovery Science will also help to accelerate the rate of change in teaching practice at the senior high level.

The following goals represent the most important senior high school outcomes of this district comprehensive plan. These goals should be achieved over the next three years, and sustained as regular occurrences in subsequent years.

GOALS:

1. All senior high school sites will develop and implement a mathematics and science instructional improvement team.

2. All feeder patterns will develop and implement feeder pattern support teams in mathematics and science.

3. All senior high school students, including students with special needs, such as LEP and standard curriculum ESE students, will demonstrate performance consistent with the Florida Sunshine State Standards and the senior high school course objectives in mathematics and science.

4. All senior high school students will increase their level of mathematics and science literacy, critical thinking skills, problem-solving ability, and ability to communicate their conceptual knowledge of mathematics and science.

5. All senior high school teachers will attain a comfort level in the curriculum, pedagogy, assessment, and the use of technology.

6. Secondary feeder pattern educational specialists will disseminate information to parents within the community regarding how the local, state, national and international standards in mathematics and science have increased. This will provide information for parents to assist their senior high school students with achieving these standards.

GOALS Continued:

7. All senior high school mathematics and science teachers will increase the use of appropriate technology within the classroom and increase the proficiency of students' use of technology as it assists with problem solving.

8. All senior high school principals and assistant principals will receive professional development designed to support mathematics and science instruction at their school. This support will assist principals and assistant principals in the promotion of mathematics and science careers, and will improve the quality of programs offered at the school site.

9. Instruction and materials that support career awareness in the areas of mathematics and science will be emphasized through schoolwide programs, such as Career and College Days, mathematics and science clubs as well as the honor societies, Career Shadowing experiences, and SECME clubs.

10. The number of senior high school students participating in the SECME program will increase at each school site.

11. The number of senior high school SECME students participating in local university outreach programs will increase at each school site. (e.g., FLAME, Build-It, Girls Symposium)

12. The number of student internships related to the fields of mathematics, science and technology as found in the One Community One Goal® initiative with the Miami-Dade Chamber of Commerce and student research programs will increase.

13. The percentage of graduating seniors who are required to enroll in remedial courses at the community college or university levels will decrease substantially.

The following activities will provide the structure for the development and implementation of a rigorous and sustainable senior high school program across the district.

ACTION PLAN:

1. All senior high schools will develop a mathematics and science instructional improvement team consisting of the assistant principal for curriculum, the mathematics and science chairperson and a representative from each course/grade level, in mathematics and science, in order to implement the *Transformative Learning Model* for professional development.

2. Secondary feeder pattern educational specialists will be assigned to feeder patterns and be responsible for facilitating the mathematics and science instructional improvement team at each respective middle and senior high school site.

3. District staff from the Division of USI Mathematics and Science and the secondary feeder pattern educational specialists will assist with the development and monitoring of professional development plans for teachers in mathematics and science.

4. District mathematics and science staff will be assigned to all school-site transition teams for development of academies and implementation of *High Schools That Work* strategies.

5. All grade 9 Algebra I teachers will deliver algebra lessons on the content of each of the five mathematics strands during each nine-week grading period. This includes a spiral of the strands, with an increased intensity of instruction in each consecutive nine-week cycle.

6. All science teachers will incorporate at least 100 minutes of laboratory experience per week into their instruction.

7. Science and mathematics teachers will work together to plan the integration of science and mathematics to support the curriculum of their specific courses.

8. Senior high school mathematics and science teachers will include meaningful mathematics and science projects that emphasize the content strands. These projects will be incorporated into classroom and home learning assignments.

9. All teachers will incorporate effective innovative pedagogy integrating the use of technology and include CRISS strategies for mathematics and science as a part of their effective teaching strategies.

10. Teachers will utilize the district-produced pretest, posttest and additional assessment instruments to assess student learning and attainment of the high school benchmarks.

11. Senior high school mathematics and science teachers will increase the use of current research-based programs and high quality materials with documented success.

12. Each senior high school will provide a Family Math/Family Science and Technology Night, and/or a Career and College Fair to inform the community and the parents about the curriculum, assessment, and courses necessary to pursue various career options.

13. Secondary feeder pattern educational specialists will plan and implement community information meetings for every senior high school within the district, to inform parents and the community about the Third Mathematics and Science Study-Repeat (TIMSS-R) data, relationships, and implications for the FCAT.

14. All high school mathematics and science teachers will encourage students to engage in executive internships with local business partners or universities.

15. Senior high school teachers will recruit SECME students for participation in internships with engineers and other science professionals and increase participation in District-sponsored SECME events.

16. The SECME staff will enhance the project efforts to place student interns in mathematics, science, technology, and engineering work settings.

17. The SECME staff will develop a quality control mechanism in an effort to maintain high standards for the expansion of the SECME program.

18. University outreach program directors will be invited to present their programs at Saturday design seminars and at the District SECME Olympiad.

19. A district committee of supervisors from mathematics and science, applied technology, and other vocational areas (e.g., Agriculture, Health Occupations) will be established to develop curriculum content crosswalks, which integrate mathematics and science concepts with practical applications and career preparation.

20. Mathematics, science and applied technology teachers will co-design professional development with the targeted goal of enhancing the instructional improvement teams.

21. District mathematics staff, science staff, and industry representatives from the targeted industries of One Community One Goal® will continue to extend focus group meetings

22. Mathematics and science department chairs and other teacher leaders will facilitate presentations/dialogue with industry/workforce representatives.

23. District staff will collaborate to develop and implement industry internships for math/science teacher leaders.

24. District staff will acquire legislative funding and support for grant proposal Future Educator's Advanced Training (F.E.A.T.) which provides for refocused preparation of mathematics and science teachers by all local colleges and universities, and includes industry mentors for prospective teachers.

25. District staff will extend and enhance university collaborative programs such as the Partnership with Academic Communities (PAC) at Florida International University, to enrich teacher and student experiences with mathematics, and INSTAR to enrich teacher and student experiences with mathematics and science at the University of Miami.

26. A committee of teachers and district staff will expand senior high school robotics projects related to U.S. FIRST competition and associated academic course work leading to product development.

EXPECTED STUDENT OUTCOMES

Senior High School Mathematics-Completing Senior High School

The curriculum will emphasize the use of the language of mathematics as a precise means of mathematical expression, mathematical communication, connections, reasoning, problem solving, mathematical modeling, and the use of technology as a teaching and learning tool. The curriculum will also provide a wide variety of strategies to solve problems. The senior high school curriculum will provide opportunities for students to understand mathematics as inquiry, reasoning, and problem solving; drawing upon connections between mathematics and real-life situations. Mathematical content must emphasize depth of understanding, rather than breadth of coverage.

Instructional design must provide students with a rationale for learning mathematics, address prior knowledge, as well as foster the application of mathematical concepts. Classroom teaching strategies must emphasize active learning, both individually and in groups. Students must be introduced to problem solving, communication, and reasoning through experiments, modeling, investigations, and real-world applications. The instruction should include the use of manipulatives, discovery method, inquiry, higher-order thinking skills, technology, context-based problem-solving activities, cooperative-learning groups, and verbal and written communication.

Assessment must be an integral part of instruction, consistent with the content, goals, and instructional design of the course. Assessment must encourage multiple approaches and make use of diverse forms and methods of assessment. Assessment should probe students' abilities to demonstrate depth, flexibility, and application of learning, as well as provide information on students' progress and learning needs.

This comprehensive senior high school curriculum will prepare students to enroll in post-secondary schools or enable them to join the workforce. They will have the mathematical and technological skills necessary for their vocational choice. They will be skilled in problem solving, communication, and collaborative teamwork.

A. Number Sense, Concepts, and Operations

During grades 9-12, student understanding of systems of numbers should be enhanced through work with matrices. Mathematics instructional programs should foster the development of number and operation sense so that all students are able to reason intelligently with quantitative information.

Students should be able to:

- Understand numbers, ways of representing numbers, relationships among numbers and number systems.
- Understand the meaning of operations and how they relate to one another.
- Use computational tools and strategies fluently and estimate appropriately.

B. Measurement

The notion of measurement includes the real-number line, the rectangular coordinate system and the polar coordinate system. Students understanding of measurement will enable them to both estimate and solve real-world problems.

Students should be able to:

- Understand attributes, units, and systems of measurement.
- Apply a variety of techniques, tools, and formulas for determining measurements.

C. Geometry and Spatial Sense

The classes of objects that form the core of senior high school geometry and spatial sense (lines, angles, polygons, circle, and a variety of three-dimensional objects) are much the same as in previous grades. Geometry learning in grades 9-12 should be focused more on the relationships among these objects than on the objects themselves or on their individual properties. The study of geometry and spatial sense in senior high school provides a means of describing, analyzing, viewing, and understanding the physical world and seeing the beauty in its structure.

Students should be able to:

- Analyze characteristics and properties of two- and three-dimensional geometric objects.
- Select and use different representational systems, including coordinate geometry and graph theory.
- Recognize the usefulness of transformations and symmetry in analyzing mathematical situations.
- Use visualization and spatial reasoning to solve problems both within and outside of mathematics.

D. Algebraic Thinking

Students should leave senior high school with a balanced understanding of functions and algebra. This includes a robust understanding of the forms and properties of a broad array of functions and the ability to use these forms and properties to solve problems in a wide range of contexts.

Students should be able to:

- Understand various types of patterns and functional relationships.
- Use symbolic forms to represent and analyze mathematical situations and structures.
- Use mathematical models and analyze change in both real and abstract contexts.

E. Data Analysis, Statistics and Probability

Students in grades 9-12 build on previous experiences with various ways of displaying univariate data, so that their knowledge can become more formal and can be used to make comparisons. Students should learn what is involved in using surveys, experimental design, and distributions to predict the likelihood of events.

Students should be able to:

- Pose questions and collect, organize, and represent data to answer those questions
- Interpret data using methods of exploratory data analysis.
- Develop and evaluate inferences, predictions, and arguments that are based on data.
- Understand and apply basic notions of chance and probability.

Senior High School Science-Completing Senior High School

The required science courses of Earth/Space Science, Biology, and Chemistry (or Physical Science) will prepare students to develop sophistication in their abilities and understanding of scientific inquiry. Investigations should derive from questions and issues that have meaning for students, such as current events and technology-related problems. Student manipulation, analysis, and interpretation of data strategies need to be modeled by science teachers and practiced by students. Determining the range, mean, and mode values of the data, plotting the data, developing mathematical functions, and looking for anomalous data are all examples of analyses students can perform.

Small group discussions, peer review, posing alternative scientific explanations, discussing sources of experimental error, labeled drawings, writings, and concept mapping should all be used by students to develop their scientific explanations. These, in turn, become the baseline for instruction as teachers help students construct explanations aligned with scientific knowledge, as well as helping them evaluate their own explanations and those made by scientists.

A. The Nature of Matter

Senior high school students develop the ability to relate the macroscopic properties of substances studied in grades K-8 to the microscopic structure of substances. This development in understanding requires students to move among three domains of thought: the macroscopic world of observable phenomena; the microscopic world of molecules, atoms, and subatomic particles; and the symbolic and mathematical world of chemical formulas, equations, and symbols.

Students should be able to:

- Describe how the electron configuration in atoms determines the way that a substance reacts and the energy involved in its reactions.
- Explain how atoms and molecules interact with each other and how their physical properties reflect the nature of their interactions.
- Design and conduct investigations to determine that the rate of reaction among atoms and molecules depend on the concentration, pressure, and temperature of the reactants and the presence or absence of catalysts.
- Explain that nuclear energy is released when small, light atoms are fused into heavier ones.
- Recognize that elements are arranged into groups and families based on similarities in electron structure and that their physical and chemical properties can be predicted.

B. Energy

Energy is an abstract but fundamental concept in science. Learning about energy is essential to understanding changes observed in nature.

Students should be able to:

- Explain that the knowledge of energy is fundamental to all the scientific disciplines.
- Describe that there is conservation of mass and energy when matter is transformed.
- Understand that temperature is a measure of the average kinetic energy of motion of the molecules in an object.
- Discuss that as electric charges oscillate, they create time-varying electric and magnetic fields that propagate away from the source as an electromagnetic wave.
- Debate the societal advantages and disadvantages of each source of energy.
- Know that the first law of thermodynamics relates the transfer of energy to the work done and the heat transferred.
- Explain that the structure of the universe is the result of interactions involving fundamental particles and basic forces and that evidence suggests that the universe contains all of the matter and energy that ever existed.

C. Force and Motion

Force and motion are essential components of the physical and biological world. In grades 9-12, the students will obtain a broader understanding of the role of different forces in the universe and will understand the importance of mathematics in science.

Students should be able to:
- Know that all motion is relative to the frame of reference.
- Calculate acceleration as change in velocity and its relationship to gravitational force.
- Describe electrical and magnetic forces.
- Compare the strength of the forces that hold the nucleus of an atom together to other universal forces and discuss the energy released in nuclear reactions.
- Explain that all forces come in pairs commonly called action and reaction.

D. Processes that Shape the Earth

The physical laws that govern the entire universe are the same ones that govern material interactions. Understanding and applying these laws to geological processes provides insight into how the earth was formed, how it has evolved, and how it continues to change.

Students should be able to:
- Know that 75 percent of the surface of the Earth is covered by water.
- Discuss that temperature, pressure, and the topography of the land influence the water cycle.
- Know that the surface of the Earth is in continuous state of change.
- Discuss climatic changes as a result of many factors.
- Describe the changes that occur within the plates of the Earth.
- Compare changes in Earth climate, geological activities, and life forms.
- Discuss that Earth's systems and organisms are the result of a long, continuous change over time.
- Discuss the interconnectedness of the systems on Earth and quality of life.

E. Earth and Space Science

During the senior high school years, students continue studying the Earth system introduced in grades 5-8. At grades 9-12, students focus on matter, energy, crustal dynamics, cycles, geochemical processes, and the expanded time scales necessary to understand events in the Earth system.

Students should be able to:
- Discuss the relationships between events on Earth and its position in the universe.
- Describe the stages in the development of stars.

- Identify bodies found within and outside the galaxy, astronomical distance and time and stellar equilibrium.
- Discuss various scientific theories on how the universe was formed.
- Describe the various ways in which scientists collect and generate data about the universe.
- Understand that mathematical models and computer simulations are used in the study of the universe.

F. Processes of Life

Students in grades K-8 should have developed a foundational understanding of life sciences. In grades 9-12, students' understanding of biology will expand by incorporating more abstract knowledge, such as the structure and function of DNA, and more comprehensive theories, such as evolution. Students' understandings should encompass scales that are both smaller, for example, molecules, and larger, for example, the biosphere.

Students should be able to:
- Know that body structures are uniquely designed and adapted for their function.
- Understand that biological systems obey the same laws of conservation as the physical systems.
- Know functions of the body such as the communication between the different parts and the response to internal and external stimuli.
- Describe the structure of the cell, the functions of the different parts, how these functions are regulated, and what affects the cell.
- List, describe, and explain, all subunits of DNA and the function of these molecules in the human body.
- Explain evolution and list the factors and consequences involved.
- Describe the interdependence of organisms.
- Understand sexual and asexual reproduction.

G. How Living Things Interact with Their Environment

Living things depend upon one another and the environment. At the senior high school level, students will obtain a more global understanding of these relationships by understanding more intrinsic interactions of the ecosystem.

Students should be able to:
- Know of the great diversity and interdependence of living things.
- Understand the flow of energy through an ecosystem and its effect.
- Describe how chemical elements make up molecules in living things.
- Understand that changes in a component of an ecosystem will affect the entire system.
- Understand genetic variations.
- Discuss ways in which humans are impacting their environment.

H. The Nature of Science

Students should recognize that science, technology, and society are interwoven and interdependent. At the senior high school level, students are exposed to more complex technology necessary to solve and measure more sophisticated scientific problems.

Students should be able to:

- Conduct investigations to explore new phenomena, check previous results, and to test and compare theories.
- Understand the implications and process of new scientific ideas, the importance of scientific responsibility, and the value of technology.
- Discuss that the laws of the universe can be discovered through systemic study.
- Understand the role of scientists in society to understand matters of public concern.
- Understand that those who engage in design and technology to solve problems apply practical scientific knowledge.

Teacher Development – School-Site Support for Improving Teaching Practice

CURRENT STATUS

Many of the professional development opportunities for the mathematics and science teachers of Miami-Dade County Public Schools could be classified as "additive" professional development of new skills to an existing repertoire, which is necessary when teachers are beginning the process of change. Continued emphasis of this type of approach, however, will no longer meet the professional growth needs of Miami-Dade County Public Schools' mathematics and science teachers if genuine change is to be sustained. It is the vision of the Division of USI Mathematics and Science to have all Miami-Dade County public schools implement a *Transformative Learning Model* of professional development at each school site. The Transformative Learning approach is defined as changes in deeply-held beliefs, knowledge, and habits of practice by teachers and by the organizations in which they teach. This approach is designed to help build a culture of continuous learning among the faculties of Miami-Dade County public schools, and a commitment to on-going improvement in the quality of teaching and learning.

A combination of increased mathematics and science course requirements, predicted teacher retirements, and the general attrition of mathematics and science teachers creates a dramatic need for the acquisition of more mathematics and science teachers to staff the classrooms of Miami-Dade County public schools. A master plan to increase the number of certified graduates prepared to teach science and mathematics, in collaboration with the local universities, is necessary and desirable.

The following goals represent the most important intended outcomes of this district comprehensive plan. These goals should be achieved over the next three years, and sustained as regular occurrences in subsequent years.

GOALS:

1. All teachers will utilize on a daily basis the best practices found in Appendix I, especially those that target curriculum, examining classroom practice, and collaboration among teachers.

2. All schools will build feeder pattern support teams that include feeder pattern educational specialists who are experts in mathematics and science, M-DCPS/FSU advanced degree teachers, and Eisenhower Resource Teachers to support the school site instructional improvement efforts.

GOALS Continued:

3. All teachers will develop an individual professional development plan as a part of PACES, and in compliance with Sections 231.085; 231.09; 231.29, F.S. These plans will focus on appropriate curriculum, instruction and assessment that support both local and national standards.

4. Feeder pattern educational specialists will disseminate information to parents within the community regarding how the local, state, national and international standards in mathematics and science have increased.

5. Principals and assistant principals will receive professional development designed to support mathematics and science instruction at their school, to promote mathematics and science careers, and to improve the quality of programs at the school site.

6. Elementary teachers will deepen their content knowledge and comfort level in teaching mathematics and science concepts.

7. Middle school teachers will deepen their content knowledge and increase their capacity to teach mathematics and science concepts within the context of effective learning theory for middle school learners.

8. Senior high school teachers will increase the use of effective pedagogy such as contextual learning to deliver the mathematics and science content to students.

9. Schoolwide instructional improvement teams will be created to implement the *Transformative Learning Model* of professional development for mathematics and science at each school site.

The following activities will provide the structure for the development and implementation of a rigorous and sustainable teacher development program across the district.

ACTION PLAN

1. Educational specialists will be responsible for facilitating the mathematics and science instructional improvement team, working with school-site administrators.

2. An intensive three-week summer leadership institute will be held for feeder pattern educational specialists assigned to feeder pattern support teams to reinforce the essential skills needed to provide effective support within each school to improve mathematics and science instruction and to model best practices. The school-site instructional improvement team will attend the last five days of this seminar.

3. The feeder pattern teams will provide support through follow-up visitations, advice, critiques of implementation of strategies, and opportunities to read and discuss the most recent research on teaching and learning mathematics and science.

4. Feeder pattern educational specialists will provide direct service to the schools by helping identify professional development needs in curriculum content in mathematics and science and facilitating appropriate inservice.

5. Feeder pattern educational specialists will facilitate sessions on a regular basis with the mathematics and science instructional improvement team to implement the specific strategies identified for professional development such as:
   - Deepening the content knowledge of mathematics and science teachers.
   - Coaching and guiding early career teachers in the curriculum areas of mathematics and science.
   - Supporting the efforts of the mathematics and science instructional improvement team to transform the teaching and learning within the school site.
   - Identifying exemplary teachers and schools.
   - Providing modeling of teaching strategies and teacher expectations of student learning.
   - Assisting in the development of assessment tasks that promote higher-order thinking skills in mathematics and science.
   - Examining student work with the mathematics and science instructional improvement team as a reflective process for professional development.
   - Reporting progress of the mathematics and science instructional improvement teams to the Region and the District offices.
   - Arranging access to people in the mathematics and science communities for experiences in real-world problem solving.
   - Providing constructive feedback to the improvement team about classroom practice.
   - Fostering leadership skills within the school-site instructional improvement team so that the team will eventually function on its own and sustain change in teaching and learning.
   - Investigating research, and planning collaborative lessons based on findings, documenting key learning in the areas of mathematics and science.

6. The mathematics and science instructional improvement team at each school will serve as teacher leaders for improved teaching practice, advocates of continuous, school improvement, and mentors of other teachers.

7. An Advisory Council to oversee the district plan will be created. It will be comprised of the Region Directors for Instructional Support, Lead Principals, supervisors of USI Mathematics and Science, and the feeder pattern educational specialists. Meetings will occur on a monthly basis to collaborate on the design framework for professional development at each school site. The focus will be to monitor, and evaluate the

progress of substantive and measurable improvement in mathematics and science instruction across the district.

8. *Equity in Mathematics and Science Education* will continue to be a critical topic in professional development for teachers, counselors and administrators.

9. *Equitable Practices in Mathematics and Science Education* will be expanded to include all instructional improvement teams.

EXPECTED LEARNING OUTCOMES FOR TEACHERS

Mathematics

The curriculum and evaluation standards entail mathematical reasoning, problem solving, communicating and connecting of mathematical concepts. They imply a significant departure from the traditional practices of mathematics teaching and focus on *what* is taught and *how* it is taught. Teachers and students have different notions about what is meant by "to know" and "to do" mathematics. Whether working individually, or in small or large groups, students should encounter, develop, and use mathematical ideas and skills in the context of genuine problems and situations. In so doing, they should develop the ability to use a variety of resources and tools when exploring "their" world of mathematics.

A. *Worthwhile Mathematical Tasks*

The teacher should be able to:
- Pose tasks that are based on problem formulation, problem solving, and mathematical reasoning.
- Engage students' intellect and develop their confidence and disposition to do relevant mathematics.
- Expand students' mathematical understanding and skills to increase their ability in communicating the mathematics in order to develop a coherent framework of mathematical ideas.
- Represent mathematics as an ongoing human activity.

B. *Teachers' Role in Discourse*

The teacher should be able to:
- Pose questions and tasks that elicit, engage, and challenge each student's thinking while listening carefully to his/her responses and ideas.
- Ask students to clarify and justify their reasoning orally and in writing.
- Decide when to provide information, when to clarify an issue, model it, lead the learner, or allow the student to struggle.

C. *Students' Role in Discourse*

The teacher should be able to:

- Guide instruction so that students listen, respond and question each other to initiate other problems and questions.
- Structure a lesson so that students validate their conjectures and solutions through mathematical evidence and arguments.
- Provide situations where students need to use a variety of tools to reason, make connections, solve problems, and communicate the mathematics.

D. *Tools for Enhancing Discourse*

The teacher should be able to:
- Use computers, calculators and other technology along with concrete materials that enable modeling.
- Utilize pictures, diagrams, tables, and graphs.
- Include written hypotheses, explanations, and arguments.

E. Learning Environment

The teacher should be able to:
- Encourage the development of mathematical skills and proficiency.
- Provide and structure the time necessary to explore sound mathematics in a collaborative or independent manner.
- Use the physical space and materials in a way that facilitates students' learning of mathematics.
- Respect and value students' ideas and diverse mathematical abilities.

F. Analysis of Teaching and Learning

The teacher should be able to:
- Observe, listen, and gather information about students to assess what and how they are learning.
- Examine the effects of the tasks, discourse, and learning environment on students' mathematical knowledge, skills, and dispositions.

Science

The teaching standards for science describes what teachers of science at all grade levels should understand and be able to do. Effective teachers of science create an environment in which they and students can work together as active learners. While students are engaged in learning about the natural world and the scientific principles needed to understand it, teachers are working with their colleagues to expand their knowledge about science teaching.

A. Plan an Inquiry-Based Science Program

Teachers should be able to:
- Develop a framework of year-long and short-term goals for students.

- Select science content and adapt and design curricula to meet the interests, knowledge, understanding, abilities, and experiences of students.
- Select teaching and assessment strategies that support the development of student understanding and nurture a community of science learners.
- Work together as colleagues within and across disciplines and grade levels.

B. Guide and Facilitate Learning

Teachers should be able to:
- Focus and support inquires while interacting with students.
- Orchestrate discourse among students about scientific ideas.
- Challenge students to accept and share responsibility for their own learning.
- Recognize and respond to student diversity and encourage all students to participate fully in science learning.
- Encourage and model the skills of scientific inquiry.

C. Engage in Ongoing Assessment of Teaching and Learning

Teachers should be able to:
- Use multiple methods and systematically gather data about student understanding and ability.
- Analyze assessment data to guide teaching.
- Guide students in self-assessment.
- Use student data, observations of teaching, and interactions with colleagues to reflect on and improve teaching practice.
- Use student data, observations of teaching, and interactions with colleagues to report student achievement and opportunities to learn to students, teachers, parents, policy makers, and the general public.

D. Design and Manage the Learning Environments

Teachers should be able to:
- Structure the time available so that students are able to engage in extended investigations.
- Create a setting for student work that is flexible and supportive of science inquiry.
- Ensure a safe working environment.
- Make the available science tools, materials, media, and technological resources accessible to students.
- Identify and use resources outside the school.
- Engage students in designing the learning environment.

E. Develop Communities of Science Learners

Teachers should be able to:
- Display and demand respect for diverse ideas, skills, and experiences of all students.

- Enable students to have a significant voice in decisions about the content and context of their work and require students to take responsibility for their learning.
- Nurture collaboration among students.
- Facilitate ongoing formal and informal discussion based on scientific discourse.

F. Actively Participate in School Science Programs

Teachers should be able to:
- Plan and develop the school science program.
- Participate in decisions concerning the allocation of time and other resources to the science program.
- Participate fully in planning and implementing professional growth and development strategies for themselves and their colleagues.

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Evaluation

Contingent upon School Board-approved level of funding of the District Comprehensive Mathematics and Science Plan the District Office of Evaluation and Research will design and implement a comprehensive evaluation of the Plan's effectiveness.

SUGGESTED EVALUATION INDICATORS OF THE DISTRICT MATHEMATICS AND SCIENCE PLAN

Data should be collected at the end of the 2000-2001 school year, to benchmark effectiveness of the district mathematics and science plan for year one. Indicators of success should include:

- The percent of students enrolled in the Superintendent's Summer Mathematics Academy year 1, who successfully complete Algebra 1 in the ninth grade.
- The percent of students enrolled in the Superintendent's Summer Mathematics Academy year 1, who score above the first quartile on the ninth grade FCAT Mathematics.
- The percent of students enrolled in the Superintendent's Summer Mathematics Academy year 2, who attain scores of level 3 or higher in FCAT Mathematics grade 8.
- The number/percent of students who meet state criteria on the Florida Comprehensive Assessment Test in Mathematics, grades 5, 8, and 10.
- The number/percent of students who successfully complete Algebra I.
- The number/percent of students who successfully complete Geometry.
- The number/percent of students who successfully complete Earth/Space Science.
- The number/percent of students who successfully complete Biology I.
- The number/percent of students who successfully complete Chemistry.
- The number/percent of students who pass the FCAT Mathematics for graduation requirement.
- The number/percent of students who score at or above the 50th percentile on the NRT FCAT in mathematics grades 3 through 10.
- The number/percent of students who score at or above the 50th percentile on the SAT 9 in science grades 5, 7, and 9.
- The number/percent of elementary students who successfully demonstrate grade level expectations on the Mathematics Assessment Instrument.
- The number/percent of senior high school graduates who pass a college placement test in mathematics upon or in preparation for entrance to college.

Similar data collection will occur at the end of year two to assist in the formulation of the plan beyond year three.

SUGGESTED EVALUATION INDICATORS OF SCHOOL-LEVEL MATHEMATICS AND SCIENCE PROGRAMS

Primary responsibility to monitor mathematics and science programs at the school level rests with the Region Offices. Monitoring school-level mathematics and science programs includes the following:

- Articulating a mathematics and science goal for each region.
- Approving mathematics plans submitted as part of the School Improvement Plan.
- Providing professional development in effective mathematics and science practices for principals and assistant principals.
- Conducting, as needed, in-school reviews of the mathematics and science plan along with the mathematics and science improvement team, using the district-developed guidelines.
- Conferring regularly with principals about the progress of the mathematics and science improvement team, their action research, and the mathematics and science programs.
- Assisting principals with the administration of program evaluation instruments that will benchmark improvements in the quality of the mathematics and science programs.

Fiscal Implications

Fiscal Implications summarizes cost areas which will be submitted for the School Board's consideration for the Summer 2000 program and for the preparation of the 2000-2001, 2001-2002, and 2002-2003 annual budgets. Options will be presented which represent alternative approaches for meeting the fiscal implications of implementing the Comprehensive Mathematics And Science Plan, *Mathematics and Science Literacy – Bridges to Careers*. Following are examples of activities, which inherently contain fiscal implications.

Summer Expenditures

The Superintendent's Summer Academy for Mathematics

The FCAT results in mathematics indicated the least amount of growth at grade 8; therefore an intensive middle school intervention will occur during each summer that the comprehensive plan is implemented. The purpose of this enhancement program is to target those middle school students that did not fail mathematics but are considered low performing. The curriculum will include extensive work in the areas of Algebraic Thinking, Geometry, and Probability and Data Analysis, better preparing these students for successful experiences in Algebra I in the ninth grade. One hundred students from each of the 53 middle schools will be included, a targeted population of 5300 students each summer.

Summer 2000 (total participants: 100 x 53 = 5300)
One hundred eighth grade students from each middle school, including LEP and standard curriculum ESE students, will participate in this mathematics program. Students will spend six weeks with expert mathematics teachers. The students will have an intense experience in pre-algebra, with curriculum designed to bridge the gap of achievement necessary to successfully complete Algebra I as ninth grade students.
Summer 2001 (total participants: 100 x 53 = 5300)
One hundred seventh and eighth grade students from each middle school, including LEP and standard curriculum ESE students, will participate in this mathematics program. Students will spend six weeks with expert mathematics teachers. The students will have an intense experience in pre-algebra, with curriculum designed to bridge the achievement gap with a focus on the five mathematics strands from the Sunshine State Standards.
Summer 2002 (total participants: 100 x 53 = 5300)
One hundred sixth and seventh grade students from each middle school, including LEP and standard curriculum ESE students, will participate in this mathematics program. Students will spend six weeks with expert mathematics teachers. The students will have an intense experience in pre-algebra, with curriculum designed to bridge the achievement gap with a focus on the five mathematics strands from the Sunshine State Standards.

Mathematics and Science Item Bank Teams

Teams of teachers will be hired to write assessment items in mathematics and science. The total number of items per bank will be approximately 192. Pretest, progress tests, and posttests will be generated from these item banks.

Summer 2000
Mathematics item banks for grades 3, 4, 6, 7, 9 will be initiated.
Summer 2001
Mathematics item banks for grades 3, 4, 5, 6, 7, 8, 9, 10 will be completed and science item banks for grades 4, 8, 10 will be initiated.
Summer 2002
Science item banks for grades 3, 4, 5, 6, 7, 8, 9, 10 will be completed.

Curriculum Revisions for Mathematics and Science

Summer 2000 -2001

- Staff will provide an alternative course by developing a mathematics course, Level 2, applications of Algebra II and Geometry as a substitute for Algebra II, the third year mathematics requirement.
- Staff will revise the Science CBC, so that the science curriculum, K-12, aligns with the Sunshine State Standards and the Florida GLE's.

Summer Leadership Institute

Summer 2000 –2002
Educational specialists will participate in the Summer Leadership Institute, with training provided by national research leaders in professional development and leadership. These leaders will facilitate the creation of a model for uniform delivery of support services and the formulation of instructional priorities.

Summer Inservice Institutes

Summer 2000 -2002
Stipends will be provided for teachers attending the summer institutes: Teachers Teaching with Technology (T^3), INSTAR, Earth and Space Science.

School Year Expenditures

Duplication

A number of documents that support the M-DCPS Comprehensive Mathematics and Science Plan have been and continue to be produced at the district level. It is essential that they be made available for teachers to use in implementing the plan.

- CBC Supplement, K-2, 3-5 and 6-8 for mathematics.
- CBC Supplement, and revisions in K-2, 3-5, and 6-8 science.

- M-DCPS Comprehensive Mathematics and Science Plan
- Grade Level Expectations for mathematics and science
- Testing materials, pretests, progress tests, and posttests for FCAT mathematics.
- TIMSS Video duplication

Personnel

Staff development is an integral component of the Comprehensive Mathematics and Science Plan. The size of M-DCPS makes it imperative that an adequate number of feeder pattern educational specialists are available to facilitate instructional improvement teams at each school site.

Substitutes
To support the level of professional development required to successfully implement the Comprehensive Mathematics and Science Plan, a number of substitute days are required.

Stipends
To support the level of professional development required to successfully implement the Comprehensive Mathematics and Science Plan, a number of stipends for Saturday workshops are required.

Secretarial Staff
An additional secretarial position is needed to support the Comprehensive Mathematics and Science Plan.

Part-Time Hourly
Curriculum revisions, provided by part-time hourly personnel, are necessary to ensure closer alignment with the Science CBC and the Florida GLE's.

Materials

Materials and supplies are necessary to enhance the mathematics and science curriculum.

Software

In order to support the current Algebra I and Geometry requirements, several pilot projects involving new software will be implemented.

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Timeline/Sequence of Activities

Following are sample sequences of activities to be carried out during the three years of implementation of the Comprehensive Mathematics and Science Plan, subject to the level and timing of School Board-approved funding.

Year 1 (2000-2001) Implementation

- Advertise, interview and select feeder pattern educational specialists for feeder pattern support teams.

- Review nationally-recognized and exemplary curriculum programs for mathematics and science for grades K-12. Select the most appropriate standards-based curricula for middle school level and senior high school level. Review nationally- recognized software programs for mathematics and science, and select those that provide maximum support for secondary curriculum objectives and provide effective use of technology in classrooms.

- Provide intersession inservice for secondary teachers in Algebra I and Geometry utilizing Teachers Teaching with Technology (T^3), Earth Space Science and INSTAR.

- Establish the Superintendent's Summer Mathematics Academy for eighth grade students to participate in the Superintendent's Summer Mathematics Academy for Algebra I preparation.

- Collaborate with the Assessment Department in the Office of Educational Planning, to write mathematics items for test item banks, grades 3, 4, 6, 7, 9.

- Review preliminary data from TIMSS-R of student performance, teacher surveys, and student surveys. Assign a review team to examine curriculum implications with Michigan State University TIMSS Student Center.

- Establish the Summer Leadership Institute for educational specialists to participate in training provided by national research leaders in professional development and leadership. These leaders will facilitate the creation of a model for uniform delivery of support services and the formulation of instructional priorities.

- Launch the Principal's Institute – Region Directors, principals, assistant principals and team leaders for school-site mathematics and science curriculum will participate in a three-day institute for orientation to *Mathematics and Science Literacy – Bridges to Careers* goals, strategies and intended outcomes.

- Meet with Region Directors for Instructional Support to describe the development of feeder pattern support teams.

- Provide an opportunity for feeder pattern educational specialists to meet with supervisors and Region Directors for Instructional Support for feeder pattern assignments.

- Conduct monthly update meetings with the steering committee of Region Directors and district staff to monitor delivery of services.

- Administer the pretest in mathematics at school sites.

- Form school-site instructional improvement teams with feeder pattern educational specialists. The teams will meet, twice a month, to analyze school improvement plans, identify instructional priorities, and determine professional development needs.

- Provide on-going support to all district schools. Educational specialists provide on-going support to all district schools by assisting with the delivery of high-quality mathematics and science instruction and improved assessment practices.

- Begin analysis of TIMSS-R data and formulate plans in conjunction with Michigan State University team to prepare curriculum implications report.

- Prepare report on curriculum implications/instruction implications of TIMSS-R. District plans for curriculum revisions and professional development are coordinated with public release of TIMSS-R benchmarking report. (February, 2001)

- Begin to revise curriculum content and sequence with respect to science and mathematics courses, with special attention given to the Applied Algebra II course.

- Administer posttest in mathematics at school sites.

- Provide eight to ten Saturday inservice days are available for each school, as needed.

Year 2 (2001-2002) Implementation

- Advertise, interview and select feeder pattern educational specialists for replacement or attrition – year one.

- Review district report on curriculum implications of TIMSS-R and district design of curriculum improvements with all educational specialists and feeder pattern support teams.

- Provide five days of intersession inservice for secondary teachers in Algebra I, Geometry, Teachers Teaching with Technology (T^3), Earth Space Science, Chemistry, and INSTAR.

- Expand participation in the Superintendent's Summer Mathematics Academy. Seventh, and eighth grade students will participate in the Superintendent's Summer Mathematics Academy in order to bridge the mathematics gap for Algebra I preparation.

- Conduct an annual review of program effectiveness year one, with Region Directors, lead principals, district staff. Include review of FCAT 2001 data.

- Continue the writing of mathematics items for test item banks, grades 3, 4, 6, 7, 9. Begin a similar project for science.

- Continue participation in the Summer Leadership Institute for professional development with feeder pattern educational specialists. These leaders will continue to facilitate the implementation of the model for uniform delivery of support services and the formulation of instructional priorities.

- Provide school-site instructional improvement teams an opportunity to join feeder pattern educational specialists in the last week of the three-week inservice, to engage in collaborative planning for scaling-up at school sites and within feeder patterns.

- Resume the Principal's Institute Year 2 – Region Directors, principals, assistant principals and team leaders for school-site mathematics and science curriculum will participate in a three-day institute on TIMSS-R implications, curriculum revisions and leadership for program improvement.

- Provide educational specialists an opportunity to meet monthly with supervisors and directors for program review and assignments.

- Expand school-site instructional improvement teams and have feeder pattern educational specialists meet twice a month with teams for the purpose of

implementing the curriculum revisions and program improvements supported in the district report for program effectiveness.

- Administer the pretest in mathematics and science at school sites.

- Continue to provide collaboration between school-site instructional improvement teams and feeder pattern educational specialists in order to implement changes in mathematics and science curriculum.

- Update school-site changes and implementation procedures. Feeder pattern educational specialists meet with district office staff twice a month for staff meetings with supervisors and directors.

- Administer posttests in mathematics and science at school sites.

- Provide eight to ten Saturday inservice days for each school, as needed.

Year 3 (2002-2003) Implementation

- Advertise, interview and select feeder pattern educational specialists for replacement or attrition-year two.

- Analyze, with curriculum review teams, the impact of curriculum revisions, the effect of nationally-recognized curricula (as utilized in M-DCPS), and the effectiveness of software programs. A final review of Applied Algebra II curriculum is submitted to the district staff.

- Provide a five-day intersession inservice for secondary teachers in Algebra I and Geometry, Teachers Teaching with Technology (T^3), Earth Space Science, and Chemistry.

- Conduct annual review of program effectiveness year two, with Region Directors, lead principals, and district staff. FCAT 2002 data are included in the review.

- Expand participation in the Superintendent's Summer Mathematics Academy for sixth and seventh grade students.

- Continue the writing of mathematics items for test item banks grades 3, 4, 6, 7, and 9. Continue with science item banks for grades 4, 7, and 9.

- Continue articulation in the Summer Leadership Institute for professional development. Feeder pattern educational specialists continue to facilitate the implementation of the model for uniform delivery of support services and the formulation of instructional priorities.

- Have school-site instructional improvement teams participate with the feeder pattern educational specialists in the last week of the three-week inservice, providing an opportunity for collaborative planning and scaling-up at school sites and within feeder patterns.

- Continue the Principal's Institute Year 3 – Region Directors, principals, assistant principals and team leaders for school-site mathematics and science curriculum participate in a three-day institute for evaluation and reflection on the comprehensive plan, analyze program impact and plan 2002-2003 priorities.

- Provide an opportunity for educational specialists to meet with supervisors and directors for assignments.

- Administer the pretest in mathematics and science at school sites.

- Expand school-site instructional improvement teams to include all mathematics and science teachers.

- Continue to provide for collaboration of school-site instructional improvement teams and feeder pattern educational specialists in order to implement changes in mathematics and science curriculum.

- Update progress of school-site improvement teams. Educational specialists meet with district office personnel for school-site progress update.

- Administer posttests in mathematics and science at school sites.

- Provide eight to ten Saturday inservice days for each school, as needed.

Appendices

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Appendix I - Best Practices in Mathematics and Science

In every mathematics and science classroom, there is a diverse pool of talent and potential. The challenge is to structure the learning environment so that each student has the freedom to use his or her unique strengths to learn, be urged, inspired, and motivated to reach high academic standards. Because all children do not learn in the same way and have varying backgrounds and experiences, flexible and innovative approaches are needed.

Preparing Students for Learning and Prior Knowledge Assessment

Teachers should inquire about students' understandings of concepts before sharing their own understandings about the topic. The technique of "frontloading" to elicit prior knowledge related to real-life experiences and applications can create a direct connection to the content for students.

Strategies: using graphic organizers (Concept Mapping, KWL), showing a video clip or model, demonstration, or using literature.

Developing Active Learners

Students can become active learners by providing opportunities for them to construct their own understanding. These situations should require students to organize, classify, interpret, and draw conclusions about real-life mathematical and scientific problems. Students must communicate their ability to problem-solve through oral, written, and physical demonstrations.

Strategies: open-ended questions, real-life scenarios to solve, and paradoxes

Teaching to Diversity

Teachers, as the facilitators of the learning process, should provide a variety of activities that address knowledge, language, and cultural differences. Activities within the classroom should include a variety of cultures, learning styles, and multiple intelligence. This will help students become aware that there are different ways of knowing and learning.

Strategies: graphic organizers such as concept mapping or KWL, incorporating verbal/linguistic, logical/mathematical, body/kinesthetic, visual/spatial, and musical/rhythmic activities, opportunities to work individually as well as in small and large groups.

Orchestrating Collaborative Discourse

There should be encouragement of student discourse within the classroom through students engaging in dialogue, both with the teacher and especially with one another. Teachers should encourage and accept student autonomy and initiative by allowing students' responses to drive the lessons, shift instructional strategies, and alter the lesson plans. The ways of representing, thinking, discussing, agreeing and disagreeing is central to what students learn about mathematics and science.

Strategies: pose questions and tasks that elicit, engage and challenge thinking; ask students to clarify, critique and justify issues, elaboration during discussions

Varying the Instructional Format

A variety of instructional formats should be used in classrooms to make sense of the content and to construct meanings from new situations. Technology is the tool to be used to develop active learning. Mathematics classrooms should foster the use of the Internet as a tool to provide real time data for student analysis, manipulatives whenever possible to teach concepts while science classrooms should provide the opportunity for inquiry-based instruction. Instead of traditional lecture-type instruction, opportunities should be provided for Internet research, small-group work, individual exploration, peer instruction, and whole-class discussion.

Strategies: use of manipulatives, hands-on activities, and technology-based activities

Using of the Learning Cycle Instructional Model

Teachers need to develop techniques that move their students from concrete to abstract concepts through frequent use of the learning cycle model. First the teacher provides an opportunity for students to generate questions and hypotheses through an open-ended discovery activity. This is followed by the concept introduction lesson(s) provided by the teacher. Finally, students must be provided with opportunities to demonstrate their understanding of the learned concept by transferring it successfully to other situations through solving a scenario, doing a demonstration, or project.

Strategies: pose scenarios to be solved

Integrating Teaching

Multi- and interdisciplinary activities should be included within the classroom that provides connections for students. Students must recognize the various roles mathematics and science play in real life. The connection and application of

mathematics and science will motivate, give meaning to, and reinforce student learning. These activities should involve students in critical thinking, process skills, and product development.

Strategies: give authentic problems to solve, bridging

Questioning for Higher-Order and Critical Thinking Skills

Use effective, open-ended questioning techniques that encourage student inquiry. Encourage students to pose their own questions, evaluate the information presented and make informed decisions about the information. Examples would include “How would you solve a similar situation?” or “What criteria would you use to …?”

Strategies: elaborating, analyzing, hypothesizing, and evaluating

Assessing Student Learning

Assessment should reflect how and what is being taught. It should be embedded at various points in the lesson to guide the instructional planning and pacing. There is a clear alignment between curriculum, instruction, and how students are assessed.

Strategies: performance tasks, essays, portfolios, video presentations, demonstrations, projects and oral presentations

Promoting Collegiality

Teacher collaboration is essential for effective teaching practices. Teachers should collaborate to establish long-range plans, prioritize curriculum, share best practices, mentor, and model lessons for each other.

Strategies: team, departmental and grade level planning, study groups, peer coaching, and mentoring

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Appendix II - Professional Development

Professional development is a continuous improvement process lasting from the time an individual enters the education profession until retirement. Selecting strategies is dependent upon knowing the primary purpose of the strategy and correlating it to the needs of the teachers involved. Some strategies fulfill some purposes better than others do. For example, strategies such as workshops are more appropriate for building content knowledge and pedagogy, whereas others, such as case studies, focus teachers on examining the practice of teaching and learning. The following are the key purposes for effective professional development:

A. *Developing Awareness:* strategies that focus on developing awareness are usually implemented in the beginning phases of change. These call for introducing teachers to new approaches or content.

B. *Building Knowledge:* strategies that focus on building knowledge provide opportunities for teachers to deepen their understanding of the mathematics and science content and teaching practices.

C. *Translating New Knowledge into Practice:* strategies that help teachers translate new knowledge into practice, engage teachers in drawing on their knowledge base to plan instruction, and improve their teaching.

D. *Practicing Teaching:* strategies that focus on practicing teaching help teachers deepen their understanding through the process of using a new approach, practice or process with their students.

E. *Reflection:* strategies that provide opportunities to reflect on teaching and learning engage teachers in assessing the impact of change on their students. These strategies also encourage teachers to reflect on one another's practice and adapting ideas for their own use.

The following fifteen strategies for professional development fulfill each purpose identified as indicated:

- <u>Immersion</u>

    1. Immersion into Problem Solving allows teachers to engage in the kinds of learning that teachers are expected to practice with their students, such as inquiry-based mathematics and science investigations.
    2. Immersion into the World of Mathematics provides teachers with an opportunity to participate in an intensive experience in the day-to-day work

of a mathematician or scientist who is engaged in research activities often in industry, a laboratory, or museum.

- Curriculum

3. Curriculum Implementation allows teachers to use and refine the use of a particular set of instructional materials in the classroom.
4. Curriculum Replacement Units allow teachers to teach a unit of instruction that addresses one topic in a way that illustrated effective teaching techniques.
5. Curriculum Development and Adaptation gives teachers the opportunity to create new instructional materials and strategies or tailoring existing ones to better meet the learning needs of culturally diverse students.

- Examining Classroom Practice

6. Action Research provides teachers with the opportunity to examine their own teaching and their students' learning by converting the learning environment into a research project in the classroom.
7. Case Discussions give teachers opportunities to study written narratives or videotapes of classroom events and discussing the problems and issues illustrated.
8. Examining Student Work and Assessments allows teachers the opportunity to examine student work so that appropriate instructional strategies and materials can be identified.

- Collaborative Work

9. Study Groups engage teachers in regular collaborative interactions around topics identified by the group, with opportunities to examine new information, reflect on classroom practice, and analyze outcome data.
10. Coaching and Mentoring allows teachers to work one-to-one with another teacher to improve teaching and learning through a variety of activities, including informal classroom observations and feedback, problem solving, and co-planning.
11. Partnerships with Mathematicians and/or Scientists in Business, Industry and Universities give teachers the chance to work collaboratively with practicing mathematicians and scientists with focus on improving teacher content knowledge, instructional materials and access to facilities.
12. Professional Networks link teachers in person or through electronic means with other teachers to explore topics of interest.

- Vehicles and Mechanisms

13. Workshops, Institutes, Courses, Seminars, Conferences, and Professional Organizations use structured opportunities outside the classroom to focus

intensely on topics of interest including mathematics and science content, and learn from others to improve their own practices.

14. Technology for Professional Development provides teachers an opportunity to use various kinds of technology, including telecommunications, video, and CD-ROMs to learn content and pedagogy.

15. Developing Teacher Leaders provides the opportunity for teachers to build upon their skills and deepen understanding of content and pedagogy needed to create worthwhile learning experiences.

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Appendix III - Limited English Proficient Students

Mathematics and science teachers who provide instruction to limited English proficient (LEP) students, must ensure that these students make academic progress while they are in the process of learning English. LEP students have to meet the same goals and objectives as students who are non-LEP. Whenever possible, beginning level LEP students should be provided content instruction in the home language of the students. However, when content instruction is provided in English, it must be made comprehensible through appropriate second language instructional strategies and clear expectations. Modifications for LEP students should include diverse teaching strategies. When assessing acquisition of content knowledge, students should not be penalized for lack of language proficiency. To support teachers of all subject areas in choosing effective strategies when working with LEP students in their classes, the following suggestions are provided. It is important to remember that these strategies should be introduced, extended, and expanded throughout all the levels according to the students' academic and linguistic abilities, and their interests.

At the beginning level, teachers should:

- start by linking lesson topics to students' prior knowledge;
- provide opportunities for students to learn and respond to the usual classroom; directions, for example, "raise your hand," or "put your name in the upper-right-hand corner," and extend those opportunities to commands dealing with mathematics and science concepts;
- use repetition and consistency to monitor comprehension of instructions and gestures;
- use cooperative learning groups where independent students and/or students at more advanced levels of language proficiency can assist beginning students;
- use visual aids and manipulatives, label classroom items; match words with pictures, items, colors, and symbols that contribute to better comprehension of content lesson(s);
- provide opportunities for students to hear and practice the content language of mathematics and science through the context of hands-on and cooperative experiences;
- categorize words, concept and ideas, which provide "hooks" for learning; and
- assign a learning buddy or mentor.

At the intermediate level, teachers should:

- include all strategies outlined for beginning level students;
- encourage students to ask questions to clarify their understanding;
- use concrete materials, hands-on activities, visuals, and real objects to provide multiple access and variety of multisensory approaches to learning;
- show students how to use graphic organizers to identify prior knowledge, prepare study guides, and restructure prior knowledge;
- provide books, articles, and other resources on content topics and teach students how to use them;

- show students how to ask and answer higher-level questions about content;
- teach and have students use technical vocabulary appropriate to the content of mathematics and science; and
- provide explicit instruction on how to use and/or develop diaries, math/science journals, projects, or picture collages.

At the advanced level, teachers should:

- include all strategies outlined for beginning and intermediate level students;
- provide clear examples of finished products when making assignments for book reports, class logs, lab reports, and research assignments related to mathematics and science; and
- check student comprehension by asking students to explain what they have heard or read and where they have seen words, phrases, or situations dealing with mathematics and science.

In general, it is recommended that teachers of LEP students:

- increase their knowledge of second language acquisition and development as it relates to teaching students the academic language of mathematics and science;
- adapt content, teaching techniques, and assessment to students' needs and levels of learning;
- encourage students to ask questions to clarify their understanding;
- involve parents and community members to build understanding through cultural exchanges;
- obtain background information about students' language and culture to ensure better understanding of students; and
- speak clearly and at normal pace with normal stress and intonation.

Appendix IV – Acronyms Used in Bridges to Careers

ACT	American College Testing
CBC	Competency-Based Curriculum
CD-ROM	Compact Disc-Read Only Memory
CRISS	Creating Independence through Student-owned Strategies
ESE	Exceptional Student Education
FCAT	Florida Comprehensive Assessment Test
F.E.A.T.	Future Educators' Advanced Training
FLAME	Florida Action for Minorities in Engineering
FOSS	Full Option Science System
FSU	Florida State University
GLE's	Grade Level Expectations
INSTAR	Investigating Nature through Student and Teacher Active Research
KAPOW	Kids and the Power of Work
KWL	Know-Want to learn-Learned
LEP	Limited English Proficient
M-DCPS	Miami-Dade County Public Schools
MIC	Mathematics In Context
NRT	Norm-Referenced Test
NSF	National Science Foundation
PAC	Partnership with Academic Communities
PACES	Professional Assessment and Comprehensive Evaluation System
SECME	Science, Engineering, Communication, Mathematics Enhancement
SMILE	Science and Mathematics Integrated with Learning Experiences
STC	Science and Technology for Children
TIMSS-R	Third International Mathematics and Science Study-Repeat
T^3	Teachers Teaching with Technology
USI	Urban Systemic Initiative

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Appendix V - Resources

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