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SECTION I: BACKGROUND AND FRAMING

INTRODUCTION

“To maintain its scientific and engineering leadership amid increasing economic and educational globalization, the United States must aggressively pursue the innovative capacity of all of its people (National Mathematics and Science Initiative, Annual Report, 2008: 5).”

“Never before has our world been so complex and science [and math] knowledge so critical to making sense of it all. Whether it is comprehending current events, choosing and using technology or making informed decisions about one’s healthcare, science [and math] understanding is key. [It] is also at the heart of the United States’ ability to continue to innovate, lead and create the jobs of the future. All students—from technicians in a hospital to workers in a high tech manufacturing facility to Ph.D. researchers—must have a solid K–12 [math and science] education (Achieve, Inc. http://www.achieve.org/files/NextGenerationScienceStandardsFactSheet.pdf).”

Proficiency in mathematics and science not only prepares our young people for the world of work, but also for the reasoning, questioning and problem solving skills necessary for personal and academic success (e.g., college and career readiness). Likewise, science and mathematics procedural knowledge and skill development helps students to become innovators, which promises unimaginable contributions to the betterment of society, both locally and globally. The potential of high quality, student-centered, math and science education that makes the need for improvement in our mathematics and science programs all the more pronounced (“Rising Above the Gathering Storm”, National Academies Press, 2007).

Unfortunately, changing traditional approaches to mathematics and science teaching and learning has been difficult, as demonstrated in mathematics and science performance data across the country, the state of Wisconsin and Milwaukee Public Schools (MPS). Too many students have limited access to the opportunities created by engaging, rigorous and relevant mathematics and science education. Achievement gaps in mathematics and science tend to be significant between white and non-white students, notably Latinos and African Americans, high- and low-income students, English proficient students and English language learners and students in low- and high-poverty schools (Education Trust, 2010). Each of these is true in MPS and across the state of Wisconsin.

Though the district has demonstrated progress in improving mathematics and science performance in recent years, such growth has been neither widespread nor expeditious. MPS continues to experience significant, though in some cases narrowing, achievement gaps between it and the state, as well as between particular student subgroups, notably White and African American and Latino students. Considerable variation in performance exists across MPS sites and grade levels.

Endemic to these trends has been the lack of a clear and consistent plan for district wide mathematics and science education, across grades. MPS schools continue to use several different mathematics and science programs that demonstrate vastly different approaches to math and science instruction. For example, in K-8 mathematics alone, MPS schools currently
use at least six different adopted textbook series, making consistent, high-quality professional development, instructional practices and accountability difficult to support system-wide.

In addition to these challenges in curriculum, instruction and assessment, a variety of data further suggest that many current mathematics and science courses lack academic rigor, particularly at the high school level and there is a lack of sufficient scaffolding in the prior years. Moreover, not every student is taught mathematics and science by a qualified teacher and there have been limited professional development opportunities. Insufficient or lack of teacher expertise may be a contributing factor (Schmidt, et al, 2011). Some high school mathematics departments, for example, have not been able to consistently maintain highly qualified mathematics teachers; i.e a department with seven mathematics teachers may have only three to four teachers with certifications in the fields in which they teach, with the remaining holding permits or in teacher training programs. In addition, while MPS has had a variety of both external champions and partners over the years, these have not always been well leveraged toward deep, sustainable and scalable change.

MPS does, however, have much to build on as it prepares for more strategic and system wide improvements in mathematics and science education. Of particular note, the Milwaukee Mathematics Partnership (MMP), an initiative of the Milwaukee Partnership Academy, funded by the National Science Foundation and the state of Wisconsin, has supported a variety of approaches to building leadership capacity for improvement in mathematics education. Data indicate that schools that adopted MMP principles and implemented with greater fidelity are in fact producing greater outcomes for students. As a result, the district showed a 10.3 percentage point gain and narrowed the district-state gap by 5.8 percentage points from 2005 to 2010 on the state mathematics assessment (Wisconsin Knowledge Concepts Examination).

In on-going efforts to improve course rigor at the high school, MPS continues development of district-wide Common Course Plans for all core high school courses and began the implementation of new, more rigorous graduation standards in 2011-12 (for the class of 2014-15). In addition, new courses are being developed to model innovative instructional strategies and advance students’ understanding and application of key mathematics, science and engineering concepts while fostering interest in science, technology, engineering and mathematics (STEM) related careers. For example, collaborations between Science Education and Career and Technical Education (CTE) staff have led to innovative work in robotics (including afterschool programs) and a series of Biomedical Science courses to support problem-based, experiential learning in high school science courses. There are a growing number of Project Lead the Way programs in district middle and high schools and Engineering is Elementary curriculum is in several district elementary schools.

In addition, a number of partnerships bring expertise and experience to the school district. The Milwaukee Science Education Coalition regularly brings together representatives from MPS, higher education, museums and other educational and community learning institutions to leverage their expertise in science education. Similarly, the Milwaukee STEM Partnership, organized by the MPS Division of Career and Technical Education, similarly engages a variety of business, industry and post-secondary education partners on Science Technology Engineering and Mathematics education programs from healthcare to automation and engineering.
There are other signs that MPS is prepared for district-wide transformation in mathematics and science education. In January 2011, MPS was awarded its largest ever, single, private grant. The $20.4 million GE Foundation Developing Futures™ in Education grant supports district-wide systems improvement and broad stakeholder engagement, particularly toward strengthening mathematics and science teaching and learning and the preparation of students for career and college readiness.

Today, Milwaukee Public Schools is well poised to confront its greatest challenge in improving mathematics and science teaching and learning – the lack of a clear, consistent vision to which all other activities and supports can be meaningfully and strategically aligned. The Comprehensive Mathematics and Science Plan (CMSP), presented here, represents such an effort to clearly define MPS’ vision and priorities for improving mathematics and science teaching and learning which is to be implemented in every MPS school, at every grade and in every course. In so doing, the district will more effectively engage parents and the community. The CMSP, an evidence-based plan, sets expectations for effective mathematics and science education, including both strategies and supports, for all MPS schools and classrooms. The plan includes:

- clear expectations for what students should know and be able to do, (e.g., concepts and skills) aligned to rigorous, 21st century mathematics and science standards – the Common Core State Standards for Mathematics and the Next Generation Science Framework;
- aligned courses/curricula that are purposefully sequenced to meaningfully scaffold student learning (e.g., learning progressions,) and ensure all students have access to rigorous course content;
- a core instructional program with explicit instructional/lesson design (including classroom environment, expected instructional minutes, pacing guides and detailed assessment and instructional strategies);
- vision and support for differentiated instruction (defined later), with particular attention to meeting the needs of struggling learners, English language learners and students with disabilities, as well as accelerated learners;
- universal screening and continuous progress monitoring;
- targeted interventions for both struggling and accelerated learners;
- variety of high-quality, curricular and instructional resources and materials, including instructional technology, for every classroom;
- aligned, high-quality professional development and implementation supports for teachers, coaches and school and district leaders;
- broad community and constituency support, including a variety of enrichment opportunities for students and staff; and
- meaningful parent and family engagement.

Planning Process
The Comprehensive Mathematics and Science Plan (CMSP) is the result of a community-wide effort to imagine more innovative and effective approaches to ensuring all MPS students
master challenging content and develop critical thinking and problem-solving skills in mathematics, science and related technology and engineering fields. With the support of GE Foundation, over 80 community volunteers, including representatives from colleges and universities, business and civic groups, nature centers, community-based organizations, the Milwaukee Board of School Directors and the Milwaukee Teachers’ Education Association, along with parents, teachers and principals were convened as a CMSP community advisory committee. The initial kick-off meeting, hosted by Discovery World, provided an opportunity for participants to learn more about the emerging math and science initiative and the important role their organizations could play in supporting the children of Milwaukee through the CMSP.

Simultaneous with these community engagement efforts, district mathematics, science and career and technical education experts, supported by other program staff (e.g., literacy, instructional technology, special education, bilingual and ESL) engaged in the following:

- studied the research in teaching and learning in mathematics and science, project based learning, professional development and targeted interventions;
- consulted with a variety of local, state and national experts;
- participated in local and national professional development focused on the Common Core State Standards and best practices; and
- conducted site visits and classroom observations in exemplar districts.

While considerable work has already been completed, the development of the CMSP is continuous; this is a dynamic document, meant to continuously evolve to meet the changing needs of MPS students, staff and community. Likewise, implementation, progress monitoring and improvement will be continuous.

**Organization of the Plan**

The CMSP articulates the MPS vision for improved mathematics and science teaching and learning, including guiding principles and conceptual framework. Following that are discussions of rigorous new standards – the Common Core State Standards for Mathematics and the Next Generation Science Framework; aligned and purposefully sequenced and paced curricula incorporating STEM integration and applications; targeted core instructional design and aligned strategies and resources (e.g., time, materials); targeted interventions for both struggling and accelerated learners; and assessment approach and continuous progress monitoring. Explicit attention to differentiated instruction and strategies for meeting the needs of students with disabilities and English language learners is also included. A comprehensive, strategic and multi-faceted approach to professional development is then detailed, as are early plans for parent and community engagement and partnership development. Additional information, including curriculum and pacing guides, approved courses and a glossary of terms, is provided in the appendices.
VISION, MISSION AND CONCEPTUAL FRAMEWORK

Vision

Every Milwaukee Public School student is mathematically and scientifically literate.

The focus on “literacy” is purposeful. To be literate in mathematics, not only should students know the mechanics of specific skills, they should be able to know in what situations these skills may be applied. The true "math literate" is not someone who has lots of math knowledge; it is someone who correctly applies the skills they do have to given situations. The Program for International Student Assessment (PISA, 2009) defines mathematical literacy as “an individual’s capacity to identify and understand the role that mathematics plays in the world, to make well-founded judgments and to use and engage with mathematics in ways that meet the needs of that individual’s life as a constructive, concerned and reflective citizen.” Therefore, mathematical literacy is an individual’s capacity to use mathematics as a fully functioning member of a global society. A mathematically literate person uses his/her procedural knowledge and skills to estimate; interpret data; solve day-to-day problems; reason in numerical, graphical and geometric situations and communicate using mathematics (Kilpatrick, Swafford, & Findell, 2001; Shau Shaughnessy, 2011).

Scientific literacy as defined by PISA (2009) is “the capacity to use scientific knowledge to identify questions and to draw evidence-based conclusions in order to understand and help make decisions about the natural world and the changes made to it through human activity.” Scientific literacy is the knowledge and understanding of scientific concepts and processes required for personal decision making, participation in civic and cultural affairs and economic productivity. These knowledge, understandings, processes and abilities are the national science standards—currently the National Science Education Standards (NSES) developed by the National Research Council of the National Academy of Sciences around 1996. The NSES will be replaced by The Next Generation Science Standards (NGSS) in March 2013.

A scientifically literate person can ask, find, or determine answers to questions derived from curiosity about everyday experiences. It means that a person has the ability to describe, explain and predict natural phenomena. Scientific literacy entails being able to read with understanding articles about science in the popular press and to engage in social conversation about the validity of the conclusions. A scientific literate person should be able to identify scientific issues underlying national and local decisions and express positions that are scientifically and technologically informed. A literate citizen should be able to evaluate the quality of scientific information on the basis of its sources and the methods used to generate it. Scientific literacy also implies the ability to pose and evaluate arguments based on evidence and apply conclusions appropriately from these arguments.

Mission

To engage students in the practices of mathematicians, scientists and engineers; to demonstrate their understanding of the natural and designed worlds; and to prepare them for success in college, careers and citizenship within the global marketplace.
Improved teaching and learning of mathematics, science, engineering and technology is essential for ensuring student career and college readiness, as well as U.S. competitiveness in the global economy. In particular, while each area represents its own domain of knowledge or discipline with specific vocabulary, concepts and processes in which students must develop understanding, they also interact in powerful ways and should not be treated as entirely separate or isolated areas of curriculum and instruction. While the CMSP focuses on mathematics and science education, MPS attention to technology and engineering education, both within these subjects and as their own subjects, is intentional and expanding. The graphic below (Figure 1) represents the interaction of the areas of science, technology, engineering and mathematics (STEM).

The CMSP is designed to connect the currently fragmented curricula to reduce redundancy, foster teacher collaboration and improve academic rigor and student engagement and learning (Metz, 2007). As natural partners, science provides real-life situations, problems and experimental data to which students can apply the tools of mathematics. For example, a presentation on findings and subsequent analyses of science experimental results often requires mathematical tables, charts and graphs. Similarly, probability and statistics are used in studies of genetics, populations and ecology. Measurements of mass, volume, distance and time are needed for most science explorations (MCREL, 2001).
Learning in mathematics, science, engineering and technology in inter-connected ways increasingly enables students to become thinkers, problem solvers and innovators in any classroom and career field. Not coincidentally, the Standards for Mathematical Practice articulate the eight areas of mathematical expertise students should develop. The Science and Engineering Practices of the Next Generation Science Framework describe what the practices scientists and engineers use to do their work.

The CMSP supports the belief that students should do mathematics and not merely identify concepts and procedures. This belief aligns with science, which consistently advocates for constructivist, hands-on, process-oriented learning. In MPS, therefore, we see the benefits of a mathematics-science partnership as helping students to:

- see the commonalities among diverse topics and the natural connections that occur between mathematics and science;
- reinforce their understanding and meaning of mathematical and scientific concepts in order to apply these to their skill development;
- engage in their own learning by connecting their personal interests to mathematics and science concepts, such as connecting physics with physical education or sports, mathematics with geography, or botany with art; and
- become effective problem solvers as they enter the world of work, perhaps as a scientist, mathematician, engineer, or technologist.
Not only do students benefit from the mathematics-science connection; teachers do as well. The enculturation of mathematics and science teachers, especially new teachers, into a system “which fosters teacher learning in a strong professional culture that promotes teacher learning across all experience levels” (Feiman-Nemser, 2003) will help sustain change and improvement efforts. In building a strong partnership between mathematics and science, teachers’ identities as discrete content specialists can no longer be fostered. Curricular conversations across these two subject domains will serve to reinforce this partnership. Based on partnership benefits and the natural linkages that exist, teachers are able to:

- provide students with a real-world learning environment, better preparing students to be college and career ready;
- deepen their own understanding of mathematics and science, mapping the intersections between the two, deepening collaborative conversations about teaching and learning; and
- design hands-on student-centered learning that is rigorous, deliberate, engaging, aligned to the Common Core State Standards and Next Generation framework and standards and supported with appropriate instructional strategies and resources.

Developing a partnership between science and mathematics curricula and increasingly engineering and technology, is a paradigm shift that requires a long-term commitment to continuous improvement. (See Section IV for a discussion of stakeholder engagement and support, as well as fidelity of implementation.) Within a high stakes accountable environment (Kerr, Marsh, Ikemoto, Darilek, & Barney, 2006), educators must be encouraged to systematically collect and use data to inform instructional decisions. In order to understand the importance of and use data for the improvement of instruction, teachers need to be involved in the continuous improvement planning process. Building on this philosophy, the CMSP provides multiple entries for teacher development, coaching, mentoring and participation in professional learning communities. It is essential to align effective and engaging teaching practices with explicit and systematic instruction to increase procedural knowledge and problem solving skills. Through the interaction of explicit instruction and the inquiry process, a balance can be reached so that

“...the process of inquiry begins when they realize they can find things out for themselves. The inquiry process takes advantage of the natural human desire to make sense of the world...this attitude of curiosity permeates the inquiry process and is the fuel that allows it to continue.”

Students learn mathematics by doing mathematics and they learn science by doing science. Effective mathematics and science classrooms provide a balanced approach to supporting student learning that includes both explicit, teacher-led instruction and structured opportunities for independent and small group practice and problem solving. It includes targeted attention to developing deep procedural knowledge, understanding concepts, building vocabulary and expanding problem solving and critical thinking skills. In these classrooms, the focus is on learning for understanding. In both mathematics and science classrooms, concepts are taught...
in depth using a learning cycle approach that includes exploration, concept introduction and concept application. To build conceptual understanding, students need to experience and process multiple examples in which the same concept is at work.

Teachers begin by determining students’ initial understandings about concepts in order to lead them to a more complete understanding through the use of strategies to retrieve knowledge, make connections and address misconceptions in light of new information. Students then need to be given opportunities to engage in tasks to explore and apply their thinking. A recommended method of teaching mathematics and science is to involve students in the processes used by scientists and mathematicians, in which they demonstrate their procedural and conceptual understanding and problem solving skills.

Meaningful practice with explicit instruction and hands-on experiences help students move beyond the concrete to abstract levels of thinking and knowing. A mathematical instructional model, Concrete-Representational-Abstract (CRA) (Montague & Garderen, 2008) is a three-part strategy. Each part builds upon previous instruction, promotes student learning and retention and deepens conceptual knowledge. This model addresses procedural and conceptual knowledge to move students from conceptual understanding to problem solving in which students acquire and apply their knowledge for solving problems. CRA supports understanding underlying mathematical concepts while learning “rules,” that is, moving from a concrete model of chips or blocks for multiplication to an abstract representation. Research-based studies show that students, including those with disabilities, who use concrete materials develop more precise and more comprehensive mental representations, often show more motivation and on-task behavior, understand mathematical ideas and better apply these ideas to life situations (Witzel, 2005; Harrison & Harrison, 1986; Suydam & Higgins, 1977). Some mathematical concepts for which structured concrete materials work well as a foundation to develop understanding of concepts include early number relations, place value, computation, fractions, decimals, measurement, geometry, money, percentage, number bases, word problems, probability and statistics.

This scaffolding continues as students apply their learning to new domains—constructing new knowledge, raising new questions and exploring hypotheses. Ongoing assessment, both formative and summative evaluation of student learning, with timely focused feedback helps students deepen this understanding. This process of ‘doing’ mathematics and science requires that teachers intentionally create opportunities for students to practice the transfer of learning. Thinking, doing and understanding of rigorous standards and practices through a balance of explicit instruction, problem solving and inquiry are the essential practices undergirding the CMSP.

Instruction should exist along a continuum of support—a gradual release of responsibility. On one end of the continuum, teachers use highly structured hands-on activities and step-by-step explanations. In the middle, inquiry is guided with science materials used to explain phenomena and mathematics manipulatives are used to reinforce concepts. At the farthest end of the continuum, students are generating their own questions and are designing and conducting investigations. Inquiry-based instructional strategies promote the following: student thinking through making observations; posing questions, examining sources of information to see what is already known; planning investigations; reviewing what is already known in light of
experimental evidence; using tools to gather, analyze and interpret data; proposing answers, explanations and predictions; and communicating the results. Reading, discussion and research are also effective techniques for practicing inquiry when scientific and mathematical questions and evidence-based arguments are used. Access to quality instructional materials—both real (science kits, sketch pads, interactive white boards, calculators) and virtual (e.g. virtual laboratories, simulations, dissections)—is essential to supporting hands-on learning and problem solving approach.

One of the goals of the CMSP is to develop a district-wide culture of developing procedural knowledge and problem solving skills through the inquiry process, in alignment with the Standards for Mathematical Practice of the Common Core State Standards and the science and engineering practices of the Next Generation Science Framework. Problem solving and inquiry are central to mathematics and science and are a primary instructional practice featured in the CMSP to connect mathematics and science teaching, learning and thinking. The National Science Education Standards (NSES) identifies three perspectives of inquiry: the instructional strategies that support student inquiry; the abilities of inquiry; and the understandings of inquiry, i.e., how teachers teach and students learn as well as what students learn. Each is an essential component of a high-quality comprehensive mathematics and science curriculum program and each perspective has a strong thread through the CMSP.

Inquiry, as an instructional approach, is a multifaceted, active learning strategy that helps students to develop critical reasoning and problem solving skills, confront new ideas, deepen their understandings and think logically and critically. In an inquiry-based classroom, students:

- rely less on knowing facts and information and more on understanding concepts and developing abilities of inquiry;
- learn subject matter disciplines in the context of inquiry;
- integrate all aspects of content versus separating knowledge and process;
- study a few fundamental concepts instead of covering many concepts;
- implement inquiry as instructional strategies, abilities; and
- focus on content, processes and skills related to essential understandings instead of implementing inquiry as an isolated set of processes.

This is a research-supported process by which student achievement in mathematics and science can increase (Sekker, 2002; Haury, 1993; Marx, 2004).

As the emphasis has shifted from teaching problem solving to teaching via problem solving (Lester, Masingila, Mau, Lambdin, dos Santon and Raymond, 1994), many writers have attempted to clarify what is meant by a problem-solving approach to teaching mathematics. The focus is on teaching mathematical topics through problem-solving contexts and inquiry-oriented environments which are characterized by the teacher 'helping students construct a deep understanding of mathematical ideas and processes by engaging them in doing mathematics: creating, conjecturing, exploring, testing and verifying' (p.154).

According to researchers and the results of several meta-analyses (Ellis, 1993; Karp & Voltz, 2000; Swanson, 2001), using a combination of direct instruction and strategy instruction has a greater positive effect than either method alone. Teachers should consider ways to use both direct instruction and strategy instruction in each lesson to gain the maximum benefit from
each approach. Teaching basic skills to students through direct instruction and then teaching them strategies to store and retrieve the information will ensure a successful educational experience for all students.

According to Leinwand (2009), an inquiry approach to teaching mathematics and science helps students to reason, question and solve problems. He purports the need to move beyond abstractions by embedding content into realistic contexts and problem situations that will bring concepts to life. When viewed through this constructivist lens, the focus of education becomes learning and the task of teaching becomes one of supporting the inquiry process (Harste, 1993).

**Conceptual Framework**

As illustrated in Figure 2 below, the CMSP calls for a systemic approach to improving mathematics and science teaching and learning that includes:

- Common Core State Standards and research-based curriculum;
- engaging materials and resources;
- rigorous and meaningful Instruction;
- standards-based assessments;
- high-quality professional development;
- leadership capacity;
- parental engagement; and
- strategic community partnerships.

Central to this effort is a commitment to quality, consistency, coherence, alignment and accountability. Each of these aspects is described further below.
Common Core State Standards and Research-based Curriculum

A curriculum is more than a collection of activities or materials. The curriculum must be coherent, focused on important mathematics and science concepts and skills and well articulated across grade levels, courses and units of study. A coherent program is one in
which ideas and skills connect and build on one another over time. They are clearly described, include specific indicators of student performance level expectations and are connected in a logical progression. A school’s mathematics and science curricula should provide a road map that helps teachers guide students to increasing levels of sophistication and depths of knowledge. Such guidance requires a well-articulated curriculum so that teachers at each level understand the mathematics and science that has been studied by students at previous grade levels and what is to be the focus at successive levels.

Mathematics and science curricula must emphasize depth over breadth and must focus on the essential ideas and processes of mathematics and science. The generally long lists of district curricular expectations have led to teaching too much too quickly with far too little depth. The most important challenge for any mathematics and science curricula is to provide an intentional focus in scope, not merely a long list of disconnected expectations. A guaranteed and viable curriculum (Marzano, 2001) needs to provide a rich, connected learning experience for students while adhering to the standards. An effective curriculum is focused, delves deeply into each topic and concept and is aligned conceptually across grades. Equally important is the curriculum’s alignment to standards and inclusion of aligned assessments. Standards-based assessments should measure the progress of student learning in the areas of understanding mathematics or science content and “doing” mathematics or science (the ability to do and understand inquiry). The nature of inquiry-based instruction lends itself to multiple forms of assessment, particularly performance tasks and authentic assessments. Alignment and coherence of these three elements - curriculum, standards and assessment - are critically important foundations of mathematics and science education.

**Engaging Materials and Resources**

In an effective classroom, students participate in multi-faceted, active learning strategies that develop critical thinking and problem-solving skills. Engaging materials and resources support this constructivist approach by integrating content knowledge with instructional technology, skills and processes. High levels of rigor are reflected in the learning materials and instructional strategies utilized by teachers. They encourage on-going discoveries, critical thinking and reflective conversations between teachers and learners, resulting in expanded understandings about how the world works.

**Rigorous and Meaningful Instruction**

The quality of instruction is the single most important component of an effective mathematics and science program. The ability to deliver effective mathematics and science instruction will determine how well students learn. Effective mathematics and science instruction is simply not a set of generic practices but instead is a set of context-driven decisions. Effective instruction is essentially effective decision making. The collection of instructional decisions made by teachers has tremendous impact on student learning and so must be intentionally sound, appropriate, strategic and deliberate. To provide an effective mathematics and science program, teachers need a thorough knowledge of how children best learn mathematics and science and also a repertoire of research-based instructional approaches that best address students’ developmental learning needs. Students need consistent, sustained engagement in the study of mathematics and science and meaningful practice of inquiry skills to create mental constructs for new learning. Effective instruction in mathematics and science must consistently
include opportunities for students to formulate questions and problems, make hypotheses and conjectures, gather and analyze data and draw and justify conclusions.

**Standards-based Assessments**

Effective mathematics and science instruction includes multiple forms of assessment and utilizes the results of these assessments to adjust and inform instruction. When the focus shifts from what was taught to what was learned, the focus must also shift to assessing what has been learned. While tests and quizzes will continue to be important assessment, it is how the results of these quizzes and tests are used that will translate into improved teaching and learning. Assessment must involve the intentional and strategic assessment of student learning within an instructional design that defines clear learning targets, progress monitoring, feedback and self-reflection, diagnosis and differentiation. Effective teachers use observations, class work, projects and similar vehicles to monitor the quality of learning. Teachers should view assessment as an essential tool to inform instructional decisions. Assessments provide an essential diagnostic snapshot about achievement and indicate where learning and content gaps may occur.

When teachers use formative and summative assessment practices and provide meaningful feedback to students and parents and families, the students who typically perform at the lower level of achievement show the greatest gains. Engaged students take ownership of their learning and become the drivers of their own success. Students need to be involved both as assessors of their own learning and as resources to other students. Assessments should provide meaningful feedback to improve instruction and serve as tools to monitor and communicate students’ progress toward achieving the mathematics and science standards. Teachers play a critical role in identifying learning goals, setting clear criteria for success and designing assessment tasks that provide evidence of student learning.

**High-Quality Professional Development**

Effective schools create and sustain a learning culture that supports ongoing professional dialogue and collaboration within the community. Effective teachers reflect on their instructional practices as part of an ongoing "plan-teach-reflect-refine-plan" cycle. In their work to analyze both effective and problematic aspects of a lesson, teachers examine student responses. Effective teachers work collaboratively with colleagues on issues of the mathematics and science embedded within lessons, the pedagogical features of the instruction and the student learning evidenced by analysis of student work. To foster continuous improvement, effective professional development includes three essential components: context, process and content. Context refers to the system or culture where new learning will be implemented. Process addresses how new knowledge and skills will be acquired. Content encompasses skills and knowledge needed for classroom teaching.

**Leadership Capacity**

An increasing body of literature (e.g., Berends, Bodilly, & Kirby, 2002; Murphy & Datnow, 2003; Supovitz & Poglinco, 2001) finds the important role that school and district leadership plays in affecting school improvement and student learning. MPS recognizes that ensuring a clear and consistent district wide vision for effective mathematics and science instruction and achieving the full potential of school and district leaders in supporting this vision requires continuous
professional learning. An effective and coherent mathematics and science program is guided by informed, consistent leadership. School and district leaders need to be aware of and implement a clear, consistent set of content standards that establish rigorous expectations for student achievement. This is especially true in meeting the complex demands of classrooms and schools (Simmons, 2006).

Despite the district’s long history of reforms, it has a more limited track record of implementing new approaches with fidelity and few at scale across the district or sustained over time. Changes in classroom practice depend in large part on the systems of support and accountability developed and implemented across organizational levels—in classrooms, schools, regions and the district. As a result, district success in implementing the CMSP will depend on quality and coordination in the system and overall leadership capacity aligned to the goals of the CMSP and focused on implementation, at scale and with fidelity. Coburn’s (2003) framework for scaling up reform, which identifies four interrelated features—depth, spread, ownership and sustainability—serves as an important guide for MPS’s efforts to create system-wide, sustainable improvements in teaching and learning in mathematics and science.

Parental Engagement
The involvement of parents, guardians and other caregivers in these learning experiences is crucial to our students’ interests and abilities to learn mathematics and science. In fact, both the National Council of Teachers of Mathematics (NCTM) and the National Science Teaching Association (NSTA) encourage parental involvement at home by promoting exploration and discovery. But the role of parents, particularly as students’ first teachers, must extend beyond support at home to ensure students, their families and their teachers share the same high expectations for student learning, understand the standards against which these are measured and share in responsibility for supporting achievement to them. Parents and other caregivers play a critical role at home, in the school and throughout our community as they become valuable partners with our teachers to promote science and mathematics learning, confidence and skills.

Strategic Community Partnerships
Effective mathematics and science instruction does not take place in isolation. It involves not only classroom teachers, but all partners in education, including parents and partners from the broader learning community. Each partner plays an important role in creating the conditions needed by teachers to provide effective instruction for developing students to their full potential. All stakeholders need to know and understand the components of an effective mathematics and science program. Regular communication between school, home, student and the community establishes crucial partnerships that support and sustain continuous improvement. The community becomes an extension of the classroom, offering abundant examples of how and why mathematics is important in people’s lives, work and thinking. School-community partnerships in support of mathematics and science instruction are essential to the development of aspiring mathematicians, scientists and engineers.

CLEAR EXPECTATIONS: COMMON CORE STATE STANDARDS
The Common Core State Standards Initiative is a state-led effort coordinated by the National Governors Association (NGA) and the Council of Chief State School Officers (CCSSO), with
the goal of providing a clear and consistent description of what K-12 students should know and be able to do in order to be ready for college and the workplace in the 21st century. Standards have been produced for English Language Arts and for Mathematics; the Science framework is in development with completed standards expected summer 2012. The state of Wisconsin adopted the Common Core State Standards (CCSS) in English Language Arts and Mathematics, making them the official Wisconsin state standards. Wisconsin has also joined a consortium of 37 states that hopes to produce the next generation of state assessments, aligned to the Common Core. More information on the CCSS initiative (in all subjects) can be found at the Core Standards website, corestandards.org.

The Common Core State Standards for Mathematics and the Next Generation Standards for Science support inquiry as an effective instructional practice to improve student learning. These standards are detailed in separate mathematics and science sections that follow.

Core Curriculum
Research consistently finds that the quality of curricula is central to effective teaching and learning. This, of course, requires a clearly defined curriculum in both mathematics and science and support in making meaningful connections between the two. MPS’s long history of decentralization, however, has proven an obstacle to ensuring consistent, high quality curricula across all grades and schools. Traditionally in MPS, schools and sometimes individual grade levels or classrooms, have chosen their own curricula and instructional materials, with little or no district guidance or accountability. As a result, it has been difficult to ensure academic rigor and alignment to standards across classrooms. The district could not ensure that all students had access to on-grade level content in the core curriculum, often referred to as Core Content (Tier I) (described below).

Tier 1 (Core Content)
The Response to Intervention (RtI) Framework is an evidence-based model for improving teaching and learning. RtI is a scaffold approach to instruction which uses data analysis to meet the academic, behavioral and social emotional needs of students using high quality differentiated, culturally responsive instruction. As depicted below and adopted across MPS, RtI models generally consist of three tiers of instructional processes, beginning with the Tier 1 (Core Content), research-based core program aligned with rigorous, grade-level standards. The center triangle within the larger triangle represents special considerations for students who may also receive tiered interventions.
More explicitly put:

“The expectation is that if the Tier 1 (Core Content) program is implemented with a high degree of integrity and by highly trained teachers, then most of the students receiving this instruction will show…a level of proficiency that meets minimal benchmarks for performance in the skill area. Many who advocate RtI models indicate that around 80%-90% of children should, theoretically, be expected to reach successful levels of competency through Tier 1 (Content Core) delivery” (http://www.rtinetwork.org/essential/tieredinstruction/tiered-instruction-and-intervention-rti-model).

Tier 1 (Core Content): Universal core curriculum instruction and practices ALL students receive.
At any given time, 80% or more of students should demonstrate sufficient progress through core instruction and/or practices. Classroom teachers provide Tier 1 (Core Content) instruction in both academics and behavior. Parents and community partners participate on various school and district committees and receive training in content areas.

Tier 2 Interventions: Intervention coupled with ongoing progress monitoring provided to students needing additional acceleration or enrichment in academics and behaviors.
Tier 2 interventions are provided in addition to core instruction. Classroom teachers typically provide academic interventions. Tier 2 behavioral (PBIS) interventions are typically provided by, but not limited to, school support staff including; school psychologists, school social workers and/or school guidance counselors. Children who require remedial or advanced support and/or small group interventions represent approximately 5-15% of the student population for whom Tier 1 (Core Content) services alone are not sufficient. Parents and community partners receive training on tiered interventions and participate in various support groups.

Tier 3 Interventions: Rigorous interventions, replacement or additional curriculum and/or instructional and behavioral strategies provided to students requiring an individualized plan of action.
Tier 3 interventions target students with significant skill deficits in specific academic and behavioral areas and eventually students demonstrating giftedness in specific areas. The goal is to have at any given time, no more than 5% of students needing tier 3 intervention supports. Tier 3 interventions are typically managed by the Tier 3 intervention team or in some cases the IEP Team. Parents and when appropriate community partners, participate in developing plans at the individual student level.

Articulation across Grade Levels and Courses
The likelihood of student success at any given grade level is not determined solely by the curriculum and instruction of that particular grade level or course, but also by the extent to which the student was prepared for that content in prior grades and courses. One of the best ways for students to learn the core concepts is to learn sequentially more sophisticated ways of building procedural knowledge to promote thinking about the concepts over multiple years.
(Donovan, & Bransford, 2005). The sequencing of courses and curricular units, as well as their alignment to rigorous standards, curriculum and pacing guides and common course plans (for high school), therefore has particular importance to both teacher planning and student learning. MPS is moving toward more clear and common sequencing of curricular content to provide all students with the necessary foundational knowledge for academic success. (See examples in the text boxes below. See more specific curriculum and pacing guides in Section II.)

Articulated Math Curriculum: In Kindergarten, teachers help children lay the foundation for understanding the base-ten system by drawing special attention to 10. Children learn to view the whole numbers 11 through 19 as ten ones and some more ones. In first grade, students learn to view ten ones as a unit called a ten. The ability to compose and decompose this unit flexibly and to view the numbers 11 to 19 as composed of one ten and some ones allows development of efficient, general base-ten methods or addition and subtraction. At grade 2, students extend their base-ten understanding to hundreds. They now add and subtract within 1000. At Grade 6, students extend their fluency with the standard algorithms, using these for all four operations with decimals and to compute quotients of multi-digit numbers. The Common Core State Standards are designed so that ideas used in base-ten computation can support later learning. For example, use of the distributive property occurs together with the idea of combining like units in the Number and Operations Base Ten and Number and Operation Fractions standards. Students use these ideas again when they calculate with polynomials in high school.

Articulated Science Curriculum: Example: Structure of Matter. In Kindergarten through 2nd grade, through multiple experiences with different types of materials and objects, students should be able to explain in what ways the characteristics and function of an object depends on the materials used to make it and the way the materials fit together. For children in grades 3-5, teachers chose experiences so that students can explain how the structure, properties and uses of objects depend on what the objects are made up of and the ways they attach to one another. At the middle grades level, teachers should provide students with direct experiences with matter or with simulations of matter to develop a basic model of matter to, for example, explain different states of substances. Students in grades 9-12 learn why particular elements interact with particular other elements and why substances have different properties (structure of the atom).

Graduation Standards

In addition to the challenges of limited articulation across existing grade levels and courses, both readiness (perceived and real) and programming issues also limit the courses to which MPS students are exposed. For example, MPS currently has no formal access to algebra—a gateway course—until 9th grade and many district students lack sufficient pre-college mathematics courses. Fifteen percent of MPS 11th graders report taking less than three years of mathematics and only 9% of the 11th graders reported taking a sequence of Algebra 1, Algebra II and Geometry. Likewise, there have not been specific standards for the nature of high school science courses needed for graduation or articulated order in which such courses should be taken. Each presents very real challenges for teachers who are often presented with students who have very different prior learning experiences.

More coherent and aligned curriculum planning and course sequencing will therefore help students and teachers build a stronger and deeper base of essential knowledge. Explicit course sequences will also provide parents and students with a clear roadmap for meeting graduation requirements and preparing for career and college success. Beginning with the class of 2014-2015, MPS will have new, common, district-wide graduation standards. As illustrated in the table below, while individual schools will, with administration approval, be allowed to add requirements for additional endorsements or program completion (e.g., International Baccalaureate diploma), all schools and students will be held to the same standards to earn an MPS diploma.
Table 1: Graduation Requirements

Overall minimum of 22 units with 16.5 units required in the following subject areas to graduate:

<table>
<thead>
<tr>
<th>Units</th>
<th>Subject</th>
<th>Requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.0</td>
<td><strong>English/Language Arts</strong></td>
<td>2 semesters each of English 9 and 10 prior to advanced courses.</td>
</tr>
</tbody>
</table>
| 3.0   | **Mathematics** (courses at or above Algebra level), per the recommended sequence as follows: | 1.0 unit of Algebra I (Gr. 9)  
1.0 unit of Geometry (Gr. 10)  
1.0 unit of Algebra II - Trigonometry (Gr. 11-12) |
| 3.0   | **Science** (content with laboratory studies), as follows: | 1.0 unit of Life Sciences  
1.0 unit of Physical Sciences  
1.0 unit of Life, Physical, or Earth & Space Sciences |
| 3.0   | **Social Studies** as follows:  | 1.0 unit of U.S. History  
1.0 unit of World History, World Geography, or World Studies  
1.0 unit of Citizenship (Gr. 9-10) or  
0.5 unit of American Government (Gr. 11-12) and 0.5 unit Economics (Gr. 11-12) |
| 1.5   | Physical Education (over a 3-year period)      |                                                                                               |
| 0.5   | Health                                          |                                                                                               |
| 1.0   | Fine Arts (Art, Music, or Theater)             |                                                                                               |
| 0.5   | Online Course, Community Service Experience, or Service Learning (one of these options) |                                                                                               |
| 16.5  | IMPORTANT: Some high schools have additional requirements for completion of specific programs or endorsements. |                                                                                               |

The district has also recently developed new, recommended high school course sequences to support greater articulation and coherence both within and across courses and ensure increased, on-time completion of MPS graduation requirements, ultimately leading to career and college readiness. The course sequences identify grade levels, order of courses and course prerequisites. They are complemented by district-approved common course plans that outline course standards and content, including essential questions. In addition, common core sequencing will help ensure instructional coherence across the high school experience, regardless of student mobility by clarifying expectations for programmers, helping staff efficiently collaborate and plan and assisting students in meeting graduation requirements.

**Academic Rigor**

A variety of student math and science performance data strongly suggest a need for greater academic rigor in high school courses if MPS is to better help students develop college and work ready skills. A new focus on common course plans, aligned adopted materials and potentially the end of course exams, along with intensive teacher supports should help to
increase course rigor. But most important in this effort is the articulation of and focus on
gerous standards and availability of aligned, high quality, consistent curricula across the
system.

**Instructional Time**

There is a considerable body of research describing the direct, positive relationship between
time for instruction and student learning, particularly depth of understanding (Clark & Linn,
2003). But while this relationship is clear, it does not necessarily mean that more time
scheduled equals more learning. Several studies, beginning with Denham & Lieberman (1980)
suggest that in addition to quantity, quality of time matters as well. They distinguish between
various types of classroom time.

All MPS schools serving grades K-8 are required to ensure a minimum of 60 minutes of
dedicated mathematics instruction each day. In high school, students are expected to earn
three credits of mathematics for graduation.

Instructional Design

Tier 1 (Core Content) guarantees access to rigorous core curricula in math and science for all
students. Most students will demonstrate proficiency with effective Tier 1 (Core Content)
consisting of differentiated instructional methods and appropriate material selection. To support
such instruction, MPS adopted Danielson’s (2007) *Framework for Effective Teaching: Components of Professional Practice*—planning, classroom environment, instruction and
professional responsibilities—as the foundation for classroom practice.

Danielson’s framework for effective teaching serves as an organizing framework for supporting
professional learning. The framework includes four key domains of classroom practice (and
teacher development) which are increasingly being used to frame and observe practice and
organize and reflect on professional development:

1. Planning and Preparation
   a. Demonstrating Knowledge of Content and Pedagogy
   b. Knowledge of Students
   c. Setting Instructional Outcomes
   d. Demonstrating Knowledge of Resources
   e. Designing Coherent Instruction
   f. Designing Student Assessments

2. The Classroom Environment
   a. Creating an Environment of Respect and Rapport
   b. Establishing a Culture for Learning
   c. Managing Classroom Procedures
   d. Managing Student Behavior
   e. Organizing Physical Space

3. Instruction
   a. Communicating with Students
b. Using Questioning and Discussion
c. Techniques
d. Engaging Students in Learning
e. Using Assessment in Instruction
f. Demonstrating Flexibility and Responsiveness

4. Professional Responsibilities
   a. Reflecting on Teaching
   b. Maintaining Accurate Records
   c. Communicating with Families
d. Participating in a Professional
e. Community
f. Growing and Developing Professionally
g. Showing Professionalism

MPS teachers are increasingly planning and delivering instruction in ways well aligned to the four domains. Likewise coaches and school and district leaders are using the framework as they conduct informal teacher observations and provide specific feedback and support for improvement. Of note, the National Council of Teachers of Mathematics (NCTM) has identified several criteria, closely aligned to Danielson’s framework, to inform instruction within the RtI model. Putting Danielson’s framework and NCTM’s criteria into action in MPS schools and classrooms requires a clear, consistent, evidence-based approach to the design of instruction. As Hensee charges, effective math and science instruction must learn from the experience of improvement efforts in literacy and be more explicitly guided by research and theory on teaching and learning in the disciplines to develop specifications to ensure the quality of instruction.

“Literacy workshops were designed by educators to maximize the use of elements that many teachers intuitively knew-and research had confirmed-helped students learn better. It is time for us to bring our best literacy teaching techniques, lessons learned from our personal experiences and results from research into math [and science] instruction” (Hensee, “Reworking the Workshop” 2002).

Launch-Explore-Summarize-Apply with 7Es
The CMSP targeted instructional/lesson design builds off experience with the Milwaukee Mathematics Partnership and the larger literatures on effective mathematics and science education, including two popular lesson-planning models. The Launch-Explore-Summarize-Apply model (Phillips, Lappan and Grant, 2000) and the 7E model (Eisenkraft, 2003) are similar instructional/lesson designs that make more explicit the practices that occur in the mathematics and science classroom during three phases of classroom instruction as described in the MPS Comprehensive Literacy Plan. These include: Whole Group (with focus on grade level standards), Small Group (differentiated instruction through small group centers/stations, independent and teacher-led guided practice, etc.) and Whole Group (generally focused on synthesizing, summarizing and assessing learning).
Both instructional designs are very different from the traditional model in which teachers often communicate facts, demonstrate procedures and then expect students to memorize these facts and practice the procedures. These designs promote problem solving in mathematics and inquiry in science in ways that expect students to explore, explain their thinking and summarize and evaluate their progress. Problem-centered teaching opens the classroom to exploring, conjecturing, reasoning and communication. This type of learning reinforces how students learn mathematics and science best, providing them with many entry points, involving them in the learning process and helping them develop and demonstrate greater metacognitive awareness.

Launch-Explore-Summarize-Apply is a balanced approach. It provides various ways to teach students by using differentiated learning strategies and providing activities to meet the needs of all learners. This model looks at instruction in three phases.

The 7E design articulates instruction using seven practices that fit well into the larger Launch-Explore-Summarize-Apply framework. The 7E instructional design expands upon the 5E model (Bybee 1997). The 5E model advocates for instruction in which students: engage, explore, explain, elaborate and evaluate the intended content. Each phase is described in the following table prepared by Rodger Bybee, et. al, 2006.

Table 2: Summary of the BSCS 5E Instructional Model

<table>
<thead>
<tr>
<th>Phase</th>
<th>Summary</th>
</tr>
</thead>
<tbody>
<tr>
<td>Engagement</td>
<td>The teacher or a curriculum task accesses the learners’ prior knowledge and helps them become engaged in a new concept through the use of short activities that promote curiosity and elicit prior knowledge. The activity should make connections between past and present learning experiences, expose prior conceptions and organized students’ thinking toward the learning outcomes of current activities.</td>
</tr>
<tr>
<td>Exploration</td>
<td>Exploration experiences provide students with a common base of activities within which current concepts (i.e. misconceptions, processes and skills are identified and conceptual change is facilitated. Learners may complete lab activities and help them use prior knowledge to generate new ideas, explore questions and possibilities and design and conduct preliminary investigation.</td>
</tr>
<tr>
<td>Explanation</td>
<td>The explanation phase focuses students’ attention on a particular aspect of their engagement and exploration experiences and provides opportunities to demonstrate their conceptual understanding, process skills, or behaviors. This phase also provides opportunities for teachers to directly introduce a concept, process, or skill. Learners explain their understanding of the concept. An explanation from the teacher or the curriculum may guide them toward a deeper understanding, which is a critical part of this phase.</td>
</tr>
<tr>
<td>Elaboration</td>
<td>Teachers challenge and extend students’ conceptual understanding and skills. Through new experiences, the students develop deeper and broader understanding, more information and adequate skills. Students apply their understanding of the concept by conducting additional activities.</td>
</tr>
</tbody>
</table>
The evaluation phase encourages students to assess their understanding and abilities and provides opportunities for teachers to evaluate student progress toward achieving the educational objectives.

The 7E model starts with elicit, moves through the 5E model as it is and ends with extend. Research supports that the added focus on the elicit and extend phases improves student learning. It should be noted that the 7E model is not linear, but cyclical. As depicted below, both models can be represented within the Whole-Small-Whole instructional design.

The table below demonstrates the similarity between the instructional design of the 2010-11 introduced Comprehensive Literacy Plan (CLP) and the instructional design of the CMSP.

Table 3: Targeted Instructional Design

<table>
<thead>
<tr>
<th>Literacy (as described in the CLP)</th>
<th>Math &amp; Science</th>
</tr>
</thead>
<tbody>
<tr>
<td>Whole</td>
<td>Launch</td>
</tr>
<tr>
<td></td>
<td>- Elicit</td>
</tr>
<tr>
<td></td>
<td>- Engage</td>
</tr>
<tr>
<td>Small</td>
<td>Explore</td>
</tr>
<tr>
<td>Whole</td>
<td>Summarize</td>
</tr>
<tr>
<td></td>
<td>- Explain</td>
</tr>
<tr>
<td></td>
<td>- Elaborate</td>
</tr>
<tr>
<td></td>
<td>Apply</td>
</tr>
<tr>
<td></td>
<td>- Evaluate</td>
</tr>
<tr>
<td></td>
<td>- Extend</td>
</tr>
</tbody>
</table>

Further description of the targeted instructional design(s) and core components can be found in later mathematics and science specific sections of the plan, as well as in the teacher planning templates that are included.

Project Based Learning

Project Based Learning (PBL) is a key area of focus of the CMSP instructional design. PBL is a student-centered instructional model in which project work is central to student understanding of the essential concepts principles and skills of a discipline. It brings together intellectual inquiry, rigorous real world standards and student engagement in a relevant, real world and authentic context. When fully implemented, PBL allows the student to take the lead, asking and answering questions and making critical choices and decisions. This form of learning draws on multiple disciplines to solve problems and deepen understanding. Most often PBL results in authentic demonstrations of useful or functional products and performances. Project-based curriculum is driven by important questions that tie content standards and higher-order thinking to real-world contexts. Often, students collaborate with outside experts and community members to answer questions and gain deeper meaning of the content. Projects are used as formative assessments providing students multiple opportunities to apply what they have learned and to produce high-quality work.
Project-Based Learning benefits include:

- the encouragement of active inquiry and higher-level thinking (Thomas, 1999);
- increased attendance, growth in self-reliance and improved attitudes toward learning (Thomas, 2000);
- academic gains equal to or better than those generated by other models, with students involved in projects taking greater responsibility for their own learning than during more traditional classroom activities (Barron, Swartz, Vye, Moore, 1998; Penuel, 1999);
- opportunities to develop complex skills, such as higher-order thinking, problem solving, collaborating and communicating; and
- access to a broad range of learning opportunities in the classroom, providing strategies for engaging culturally diverse learners (Railsback, 2002).

**MATERIALS AND RESOURCES**

Effective instruction is supported by high quality materials and resources provided in a way that minimizes teacher preparation and maximizes student learning. Instructional materials and resources for mathematics and science classrooms include textbooks, math manipulatives, graphing calculators, laboratory manuals, kits, tradebooks, instructional technology (i.e., software programs, multimedia, webcams and world-wide networks).

School districts with successful mathematics and science programs support classroom learning by supplying materials and resources to classrooms to enable student exploration, observations and analysis. Quality instructional materials and resources should enhance student understanding; promote students' active involvement, incorporate inquiry, use an appropriate learning sequence, include assessment methods and reflect current research. They should also give students opportunities to communicate verbally and in writing.

Teacher demonstrations and student presentations can be more engaging and accurate using technology such as projected microscopic images or computer-generated graphs. Opportunities to integrate multimedia resources with mathematics and science learning also help teachers provide more engaging learning environments and meet needs to extend the curriculum to student interests and further research.

Professional development specific to the instructional materials and resources is needed for optimal use. These materials, resources and aligned teacher skills are critical for effective mathematics and science teaching and learning.
DIFFERENTIATED INSTRUCTION, WITHIN THE CORE

Promoting a culture of and support for achievement to high expectations for all students is a fundamental goal of the Common Core State Standards and the Next Generation Science Framework, as well as a core value and commitment of the CMSP and Milwaukee Public Schools.

To meet these expectations, effective instruction is deliberately designed to respond to the individual needs of all learners—notably struggling learners, students with disabilities and English Language Learners, as well as accelerated learners. This occurs both within Tier 1 (Core Content), as well as in more targeted, supplemental Tier 2 and 3 interventions (as described later). In the former, the focus is still on grade-level standards, but may include some explicit pre-teaching or more intensive re-teaching/review of core concepts, specific scaffolding to better access students’ prior knowledge, use of varied texts or visual cues, or any of a myriad of other evidence-based strategies.

As articulated consistently in professional development across stakeholders (e.g., teachers, coaches and school and district leaders), MPS describes differentiated instruction as such:

Differentiated instruction is a concept that makes it possible to maximize learning for ALL students. It is a collection of instructionally intelligent strategies based on student-centered, best practices that make it possible for teachers to meaningfully respond to the needs of diverse learners. It is made possible by modifying the content, process and/or product of instruction of a particular student or small group of students (typically to scaffold and extend learning), rather than the more typical pattern of teaching the class as though all individuals in it were basically the same. Differentiated instruction is an approach to ensuring all children achieve to the same high standards; instructional approaches are varied, not the expectations or the standards.

In classroom practice, differentiation occurs primarily in the following:

- **Content**: What is the standard to which I am going to teach? What skill am I going to teach?
- **Materials**: What resources do I need to teach the particular knowledge or skills? How will these be varied for different students?
- **Process**: How am I going to teach that skill in a variety of ways that will address the developmental levels of each of my students?
- **Product and Assessment**: What will my students produce as evidence of understanding of the skill?

In planning effective lessons, teachers take into account students’ developmental readiness, prior knowledge and a student’s individual pattern of informal and formal mathematical and scientific strengths and weaknesses. Teachers should employ instructional tools such as interactive activities, multiple representations, manipulatives, cooperative work, calculators and other technology carefully and reflectively. Pedagogical experiences should include both investigative approaches and inquiry-based instruction (Broody, 1998). One research-based
instructional approach, described earlier, especially supportive of differentiated instruction is the Concrete to Representational to Abstract (CRA).

- Concrete the “doing” stage using concrete objects to model problem.
- Representational is the intention of MPS, as part of the implementation of this Comprehensive Plan, to use district leadership, professional development and coaching to ensure that these characteristics of successful classrooms are consistently found throughout the district. “Seeing” stage, using representations of the objects to model problems.
- Abstract, the “symbolic” stage using abstract symbols to model problems.

Students who use concrete materials develop more precise and more comprehensive mental representations, often show more motivation and on-task behavior, understand mathematical ideas and better apply these ideas to life situations (Harrison & Harrison, 1986; Suydam & Higgins, 1977). Some mathematical concepts for which structured concrete materials work well as a foundation to develop understanding of concepts are early number relations, place value, computation, fractions, decimals, measurement, geometry, money, percentage, number bases, word problems, probability and statistics.

Another approach to meeting the diverse needs of students in today’s classroom is incorporating multiple representations of mathematical ideas. Doing so increases the probability that teachers will reach every student through an efficient and effective personal learning style (Lesh, Post & Behr, 1987; Fennell and College, 2011). Teachers must represent mathematical ideas in multiple ways to expand students’ understanding of core ideas and to help them see connections among these ideas.

**Meeting the Needs of Students with Disabilities**

MPS is committed to ensuring the least restrictive environment (LRE). Students receiving services from special education are students first. Their one common characteristic is that they have a disability that significantly interferes with their ability to progress in general curriculum. All school staff need to play a role in the education of students who struggle, including students with disabilities. In order for students with disabilities to meet high academic standards and to fully demonstrate their conceptual and procedural knowledge and skills in science and mathematics, their instruction must incorporate purposeful supports and accommodations, including: 1) supports and related services to meet the unique needs of these students and to enable their access to the general education curriculum, 2) an individualized education program (IEP) and 3) teachers and specialized instructional support personnel who are prepared to deliver individualized instruction and support services.

**Key Program Components**

The International Center for Leadership in Education has identified five key components that schools must address to support achievement for students in special education. These elements include: ownership, high expectations, intervention systems, collaborative teaching and professional development (McNulty, Gloecker, 2011). Described below, these key components will be the basis of supporting students identified for special services in the
CMSP. Of note though, these elements show promise for English Language Learners (ELL), students receiving services from special education and students who exceed expectations and need academic acceleration.

- **Ownership**
  A school-wide collaborative culture needs to be established where the achievement of all students is a shared responsibility of administrators and faculty. Building administrators must take the lead for setting a tone of collective leadership and must serve as primary advocates for the students who need support beyond the standard curriculum and instruction (McNulty and Gloecker, 2011). MPS administrators must ensure that all teachers have the opportunity to share in the planning, implementation and assessment practices needed to support students in achieving mathematics proficiency at their grade level.

- **High Expectations for All**
  Setting high expectations for all students provides clear direction. Five teacher practices that will ensure access to learning for all students: (1) implementation of the CCSS for Math Practice and Mathematical content (2) implementation of the MPS Comprehensive Mathematics Framework (3) use pedagogical experiences that scaffold learning from concrete to representational to abstract (4) organization of challenging and supportive classroom learning environments (5) use of diagnostic assessment practices.
    
    o Common Core State Standards and the Next Generation Science Standards and Framework articulate rigorous grade-level expectations in mathematics and science. Under IDEA, students with disabilities must be challenged to excel within the general curriculum and be prepared for success throughout the rest of their lives. In order for students to demonstrate their conceptual and procedural knowledge, they must engage in a balance of rich learning experiences that encompass the standards.
    

- **Collaborative Teaching**
  All models of co-teaching require sharing of instructional responsibility, resources and accountability. Teachers plan, present, evaluate instruction and monitor student progress. Both teachers supply instruction and support services when co-teaching and both should define their exact roles collaboratively. The classroom teacher and special education teacher together review the mathematics instructional goals for the class and anticipate any problem areas that may require special planning. A ratio of one-third or fewer special education students to general education students is the recommendation for classroom. Both teachers must be equal partners in the co-teaching environment, which requires mutual respect and adaptability. Five models of collaborative teaching have been researched and will be further reviewed for implementation of the CMSP.
- **Professional Development**

Special Education teachers, as well as general education teachers, must stay abreast of the mathematics and science standards and aligned curricula and instruction. Students, in classrooms of teachers who have engaged in professional development in working with children with special needs, outperform other students by more than one-full grade level (Fennell and College, 2011). Professional development for staff both district wide and school-based. Classroom follow-up will provide teachers with a variety of strategies to assist teachers in being able to internalize their new learning (Fennell and College, 2011).

CMSP-related professional development, which is more detailed in later sections, will include specific attention to the following in support of improved teaching and learning for students with disabilities:

- deepening understanding of mathematical content knowledge and the CCSS;
- collaborative teaching and its role in supporting all learners;
- pedagogical strategies such as Think Aloud and Effective talk formats; and
- assessment practices, both formative and diagnostic.

**Meeting the Needs of English Language Learners**

English Language Learners (ELL) are students whose first language is not English or the academic language of the classroom and have limited English proficiency. The National Clearinghouse for Bilingual Education (NCBE) also refers to this group as linguistically and culturally diverse learners (LCDL) (NCBE, 1999). To ensure that these students have access to rigorous mathematics and science curricula and instruction in all classrooms, several research-based structures are recommended and supported in MPS.

**ELL Identification and Programs**

The district works to ensure that all ELLs are correctly identified and receive targeted program supports aligned to their learning needs. While this is the most obvious step, a variety of school and community conditions, including parents’ understanding of program types, identification processes and potential implications of identification often present challenges. After appropriate identification measures are done and the ELL student’s language proficiency level (LAU level) is determined, parents must be offered a student placement within either a bilingual or English as a Second Language (ESL) program site developed to support their child’s academic and social/instructional language learning needs. While parents always have the choice of the specific language development supports (as well as refusal of services), the best scenario for ELLs is to be provided targeted language support services with expert staff and high quality materials, simultaneous with high quality content-specific instruction. Access to rigorous mathematics and/or science instruction should neither be delayed nor diminished (e.g., reduced instructional minutes).

MPS currently provides two forms of targeted language learning support programs to ELLs, stand-alone English as a Second Language (ESL) and developmental bilingual education. The latter provides linguistically and culturally distinct students with an opportunity to experience early academic success in their first language while learning English as a second language. It is an educational process, which enhances language skills acquisition and fosters basic skills development. In addition, it creates a multicultural environment whereby students’ appreciation
for their own and other cultures is encouraged. Programs are designed to ensure that language minority students become fluent and literate in English while also stressing the retention and development of the primary language and use of that language as a vehicle for developing both learning a second language and academic content (e.g., mathematics and science) to high standards. There are approximately 23 schools in MPS that have bilingual classes focused on helping students achieve two major content learning goals:

- Achieve at a rate commensurate with their own age, ability and grade level in all school subject areas as measured by their grades, grade point average and other performance assessments.
- Acquire the basic skills and knowledge of subject content and concepts needed to succeed in the world of work and to promote lifelong learning as measured by their grade point average and other performance assessments.

Of special note, the following should be considered for students in bilingual classes to be successful in learning challenging mathematics and science content, concepts and skills:

- Students in bilingual classes have teachers who have both bilingual certification and content-area certification.
- Students need mathematics textbooks and workbooks in both English and Spanish.
- Content areas require a specific percentage of English content instruction per grade level for students in the bilingual program.
- According to the language of instruction that day/week, students should receive the same amount of math content as students in the monolingual classes, K-12. For example, after exploring and summarizing a math lesson in Spanish, the teacher should reinforce key vocabulary terms and descriptions in English. Teachers can use the academic vocabulary grade-level lists on the MPS portal for assistance.

Students in the Bilingual Multicultural Program must have access to the same content, materials and quality of instruction that are available to monolingual students.

Regardless of program type, learning is the process of developing and negotiating meaning in context, which is done through language. The English Language Learner’s ability to participate in mathematics and science classrooms is dependent on his/her language skills: listening, speaking, reading, writing and understanding. Science and mathematics can be particularly challenging to ELLs because each demands specific linguistic, conceptual and procedural knowledge. MPS is therefore working to ensure all teachers of ELLs, whether in bilingual or ESL classrooms, are more proactive in meeting the needs of ELL students (and all students). The effort includes the following best practices and pedagogy in all classrooms. (Note the similarities to key program components for effectively serving students with disabilities as described earlier). These are increasingly incorporated in district planning and professional development.

**Successful Classroom Characteristics:**

- Assess the linguistic demands of particular lessons and plan accordingly. Teachers should be aware of the complexity of the language used in a specific lesson and work to limit and/or scaffold this to reduce unnecessary cognitive demands, confusion and
frustration related to the student’s language proficiency and instead focus on the specific mathematics or science learning objectives. Of note though, in this effort teachers should strive to maintain the depth of knowledge and complexity of thought of the specific content area lesson. The mathematics or science teacher should also work to reinforce and support language and literacy learning.

- Activate prior knowledge with some purposeful vocabulary instruction around the language of mathematics and science in the lesson. Vocabulary is central to the process of constructing meaning, developing a conceptual understanding and for communicating one’s thought process. Academic standards in both science and mathematics require students to apply computational skills in a variety of real-life problem-solving situations, read and solve word problems, communicate their thinking and collaborate with their peers to complete a task. Each content area has its own specialized language (i.e. table vs. table), grammatical patterns (logical connectors) and rules (action problems may consist of either changing or equalizing problems). While ELLs are learning English, they must also learn the unique meanings that some English words have in mathematics or science contexts. Math and science teachers who work with ELLs must utilize a dual approach of incorporating instruction of the content-specific language related to particular concepts being taught along with the concepts themselves. It is recommended that teachers use familiar language when teaching unfamiliar concepts and unfamiliar language only when dealing with familiar concepts. Using models or realia, picture word walls, gestures or actions and the like teachers can make the language of math and science come alive for students. Bringing the content words to the forefront before, during and after instruction will help students understand the context of the words.

- Engage students in tasks that are multi dimensional and worthwhile. Authentic problem solving contexts should be central to the math and science classroom. Begin with rich tasks that keep the cognitive demand of the task high and encourage critical thinking skills. Students need to be taught problem-solving steps: understand the question, find the needed information, choose a plan, solve the problem and check back. Each of these steps must be comprehensible to the language learner. Teachers must introduce mathematics and science facts and concepts concurrently with the problem-solving steps and continue to reinforce these. For example, naked numbers and basic skills should not be the central focus of the lesson, but embedded in the lesson.

- Require mathematical and/or scientific discourse throughout the lesson. As students engage in conversations about the math (in English and native language) they are able to make sense of the content and the language. Activities must be included that allow ELLs to test language and comprehension. Cooperative grouping where students can discuss their understanding of a problem, identify steps needed to solve a problem and check understanding with other students is one such procedure. Oftentimes, the simple act of talking through a problem provides the ELL critical practice in thinking and learning in the content area. Several additional strategies support this tactic, from the Think Pair Share and the Think Aloud, to an active partner or group discussion. For students who are not comfortable with speaking the Think Pair Write along with the use
of a math or science journal to explore different solution strategies without having to “speak” in front of the class. Along with writing support, teachers should use sentence frames that help ELL students learn the structure of language to support their written work.

- Use a student centered, cultural relevant pedagogy approach. Culturally relevant pedagogy helps students make connections to other areas of study and links new content to prior learning. Just as one textbook differs from another textbook in its approach to teaching a concept, various cultures around the world approach math and science concepts and processes using different methods. For example, in some cultures, periods are used instead of commas to separate multiples of a thousand - 1,200,000 could be written as 1.200.000 in some cultures. Likewise, false cognates can cause confusion and frustration for ELLs. (For example, in Spanish, “mil” translates to the English “thousand,” not million.) Without a clear understanding of how mathematics and science in U.S. classrooms can be culturally different and challenging for ELLs, teachers may make false assumptions. A teacher may assume that a student that uses a period instead of a comma to separate the thousands place when writing a number is making a careless error when, in fact, in the student’s home country, he/she has written the number correctly. Teachers can assist ELLs by being aware of cultural differences so they can understand academic behaviors and performance in the mathematics or science class.

However, because even the best teachers cannot be familiar with and predict all the possible areas of cross cultural confusion for their diverse students, teachers are also encouraged, as suggested throughout, to pay special attention to presenting information through multiple modalities and continuously reinforce key concepts and skills. Teachers should also heighten their observation of student problem solving approaches and learning progress to quickly identify and resolve areas of confusion. Cognitively Guided Instruction (CGI) encourages teachers to use the prior knowledge and developing thought processes of their ELLs in structuring lessons and curricula. The lesson launch is key opportunity for doing this.

- Vary instructional methods. Teachers should vary their instructional methods with a mix of individual, small group and whole group learning opportunities throughout a lesson. The use of instructional methods must align to the learning outcomes (learning intentions and success criteria) of each lesson. Multiple representations within the lesson (numbers, words, symbols, graphs, pictures, physical models or manipulatives, tables, etc.) will enable more students to access the content. As such, teachers are encouraged to design multi-sensory lessons (visual, auditory, tactile and kinesthetic) and use multiple representations within the lesson (numbers, words, symbols, graphs, pictures, physical models or manipulatives, tables, etc.) to enable more students to access the content. Visuals (i.e., charts, graphs, realia, diagrams, models) reinforce auditory instruction. Likewise, use of graphic organizers to visually represent mathematical concepts and hands-on activities, as well as real-life problem-solving situations can help to both introduce and reinforce new concepts. Explicit, interdisciplinary connections also promise to support learning.
• Instructional Technology. Teach students how and when to use calculators and other supports. Incorporate SMART Notebook applications into lessons and videos that demonstrate a concept. Have students use computer based programs that support the math and science in the lesson like *Discovery Education Science* and the *Illuminations* web-based software available at the NCTM website.

• Assessment. Students should have the opportunity to be assessed in multiple ways. Teachers should be gathering daily formative assessment (success criteria) from the daily lesson to check for student progress and understanding. Teachers need to be clear about the standards they are assessing and what they want students to be able to do to demonstrate their abilities to that standard. Other assessments should include anecdotal records, interviews, checklists, portfolios and performance based assessments. Teachers should also consider the directions, extra time, use of support materials and the like for ELL students to use on tests making sure that the assessment is on the math and not the student’s ability to use and understand the English language. Using assessment approaches that accommodate students’ varying background knowledge or learning style and language levels provides greater reliability, validity and usefulness.

• Cultural Responsiveness and Respect. Teachers could have students teach him or her how to pronounce the words in the student’s home language.

The pages that follow offer more specific guidance for meeting the needs of ELLs and Students with Disabilities.

**Available Accommodations in the Core Curriculum for Students with Disabilities and English Language Learners**

**NOTE:** Accommodations are minor changes that “level the playing field” for students without changing the content, expectations or activities. When a student’s disability warrants a more pervasive and persistent need for an accommodation, the IEP should reflect this accurately. However, all accommodations should be viewed as temporary. In order to achieve high expectations, plans should be made to fade out accommodations whenever possible.

| Examples of accommodations for English Language Learners include but are not limited to: |
| **English Language Reference Material:** English and native language support materials to assist with comprehension, define words and/or help students respond to task (Example: Provide spelling assistance). |
| **Scripted Oral English:** Reading aloud and repeating items or directions verbatim (Example: Read mathematics items to student in English). |
| **Clarification in English:** Oral explanation of text considered potentially difficult for ELLs to access (Example: simplify, explain, or clarify directions). |
| **Oral Response:** Student answers orally in English (Example: Student indicates response in... |
Direct Linguistic Support in the Student’s Native Language

**Dual Language Reference Material:** Support material in English and native language, not intended to define words or provide answers for student (Example: Bilingual word-to-word – no definition – translation on mathematics and/or other content areas.

**Written Translation:** Professionally translated written accommodation scripts provided to student (Example: qualified translator provided written translation in the student’s native language on mathematics and/or other content areas.

**Scripted Oral Translation:** Reading aloud professionally translated, DPI-provided scripts of all items and/or directions for instruction (Example: Read mathematics items using DPI-provided Spanish script).

**Sight Translation-Languages other than Spanish:** Unscripted oral translation of items and/or directions into student’s native language. (Example: Interpret passages and questions into student’s native language).

**Student Response in Native Language:** Student responds in his/her native language (Example: Student responds orally in his/her native language; translator translates and scribes student response into English.

[http://dpi.state.wi.us/oea/pdf/accomell.pdf](http://dpi.state.wi.us/oea/pdf/accomell.pdf)

Accommodations for students with disabilities would include, but are not limited to:

**Directions:** Accommodations are for clarification of directions and are separate from accommodations for test items. (Examples: Sign language for directions, explain or clarify directions, etc.)

**Content Presentation:** Accommodations allow an assessment to be given to a student in a different format or mode of access that may be auditory, multi-sensory, tactile, or visual. (Examples: Large-print, audio recording, Braille, etc.)

**Response:** Accommodations allow a student to respond to each test item or organize work using an assistive device. (Example: Student responds orally to a scribe who documents the student’s answers, use of a graphic organizer, etc.)

**Setting:** Accommodations allow a student to take an assessment in a different location or environment than the rest of his or her class. (Example: Individual testing, student stands or moves during testing, etc.)

**Timing/Scheduling:** Accommodations increase the allowable length of time to complete an assessment or change the way the time is organized. (Example Extra time, testing across multiple days, etc.)

Available Modifications to Provide Access to the Core Curriculum for Pre-K-12 Students with Disabilities
NOTE: Modifications are used only for students with disabilities based on their Individual Education Plan (IEP). Modifications are changes to the regular curriculum that impact the content, expectations and/or activities.

Available Modifications to Provide Access to the Core Curriculum for Pre-K Students with Disabilities - Some common modifications include, but are not limited to:

- **Alternative grading** – reshaping the grading process in some way. Giving partial credit on a science test is rare in the general education setting; but if a child with reading difficulties answers 1 part of a 3-part question they can receive partial or complete credit.
- **Partial participation** – used with students with more severe disabilities. Whether it is has to do with attention span, physical limitations, or cognitive abilities, there are many students for whom partial participation *is* success. An example would be to have a student complete just the computation section of a math assignment or completing a math assignment using a calculator.
- **Parallel instruction** – students learn together as a class, but the expectations placed on students vary from individual student to individual student. This is similar to the concept of differentiated instruction but the child may be working on functional math aligned to extended grade band standards but not the math assignment that the rest of the class is working on.
- **Alternative materials** – for example, the use of picture books or shorter texts instead of chapter books to teach a science or a social studies lesson.

Read more at Suite 101: Vocab: Modifications
(http://specialneedseducation.suite101.com/article.cfm/modifications#ixzz0tsWPKtfa)

### Assistive Technology Devices for Students with Disabilities in Mathematics / Science

A range of assistive technology supports can be used by students who are struggling in mathematics or science. Assistive technology levels the playing field by providing access to curriculum through the use of both high and low technology devices. The types of assistive technology supports used are determined by individual student abilities and needs as well as the required mathematical tasks across all instructional environments. Any assistive technology that is *necessary* for academic success of students with disabilities must be documented in their IEP.

In this document, assistive technology supports are organized into various categories based on the primary features or applications of the technology. Moreover, the age ranges for which the supports are appropriate are identified in the following categories: elementary, middle and high school. It is recommended that individuals utilizing this document refer to the standards to determine the specific skills that are addressed at each grade level.

Adapted from the Georgia Project for Assistive Technology, a project of the Georgia Department of Education, Division for Special Education Supports. Permission to photocopy is granted for non-commercial purposes if this credit is retained. An updated version of the original document will be posted on the project’s website at http://www.gpat.org. © August 2010.
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<td>----------------------------------</td>
<td>--------------------------------------------------------------------------</td>
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</tr>
<tr>
<td></td>
<td></td>
<td>Elementary</td>
<td>Number &amp; Number</td>
</tr>
<tr>
<td>Electronic Math Processing</td>
<td>Virtual Pencil series (Henter Math)</td>
<td>X X X X</td>
<td>X</td>
</tr>
<tr>
<td>Software (continued)</td>
<td>Geometer’s Sketchpad (Key Curriculum Press)</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td></td>
<td>Algebrator (Sofmath)</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Manipulatives</td>
<td>Everyday Math Aids - Money</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Bills, coins - Hands on Money (Attainment)</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td></td>
<td>Bills, coins, stickers, trays - (Creative Presentation Resources, PCI Educational Publishing)</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Charts &amp; Study Guides</td>
<td>Check writing and banking sets (PCI Educational Publishing)</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Calculators</td>
<td>Coin Abacus (PCI Educational Publishing)</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Adapated Rulers</td>
<td>Everyday Math Aids - Measurement</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Master Ruler (Onion Mountain Technology)</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td></td>
<td>Finger Grip Ruler (Onion Mountain Technology)</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td></td>
<td>Large Number Rulers (Fiskars, office supply)</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Support Category</td>
<td>Examples</td>
<td>Age Range</td>
<td>Content Strands</td>
</tr>
<tr>
<td>----------------------------------</td>
<td>------------------------------------------------------------</td>
<td>-----------</td>
<td>-----------------</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Elementary</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Middle School</td>
<td>High School</td>
</tr>
<tr>
<td>Adapted Tape Measure</td>
<td>Fractional tape measure (Lufkin, StanleyTools)</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td></td>
<td>Talking Tape Measure (LLS Group, MaxiAids)</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Adapted Measuring Supports</td>
<td>Talking Measuring Jug (Independent Living Aids)</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td></td>
<td>Teaspoon Measuring Syringe (Independent Living Aids)</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td></td>
<td>Color Coded Measuring Cups (MaxiAids)</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td></td>
<td>Big Number Funnel Set (MaxiAids)</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Manipulatives</td>
<td>Everyday Math Aids - Time</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>TimeWheel 2 (Attainment)</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td></td>
<td>Master Clock (Onion Mountain Technology)</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Adapted Watches</td>
<td>Teaching watches</td>
<td>X</td>
<td></td>
</tr>
</tbody>
</table>
STANDARDS-BASED ASSESSMENT (OF AND FOR STUDENT LEARNING)

Central to continuous improvement is ongoing assessment of and for student learning, meaningful (e.g., task-specific) feedback and reflection and timely, mid-course corrections and targeted support aligned to the needs of the learner. In MPS, mathematics and science assessments range from teacher-specific strategies to standardized, district wide (e.g., CABS and universal screeners) and statewide assessments (e.g., WKCE-CRT). Black and William (1998) define assessment broadly to include all activities that teachers and students undertake to get information that can be used diagnostically to alter teaching and learning. It is therefore an essential aspect of effective instruction, especially our ongoing efforts to meet the needs of all learners and continuously improve in this regard.

Student achievement of standards and objectives is best assessed using a variety of assessment instruments. Effective teachers use a variety of classroom assessment approaches in conjunction with standard assessment instruments to inform instruction. Assessment encompasses teacher observation, classroom discussion and analysis of student work, including homework and tests. Observation of students engaged in instructional activities is highly recommended as a way to assess students’ skills as well as attitudes toward learning. The nature of the questions posed by students provides important evidence of their understanding of mathematics.

Assessments become formative when the gathered information is used to adapt teaching and learning to meet the needs of students. When teachers know how students are progressing and where they are having trouble, they can use this information to make necessary instructional adjustments, such as re-teaching, trying alternative instructional approaches, or offering more opportunities for practice. These activities can lead to improved student success.

Formative Assessment

Formative assessment is not evaluative or grade generating, but allows students to engage in a self-reflective process that improves the quality of their learning and skill. These assessments afford the teacher a window to study student understanding during the instructional cycle. Ultimately, the strategic and timely revision of instruction, based on information obtained through this window, enhances students' ability to demonstrate mastery on culminating assessments and evaluative tools such as standardized tests.
Below is a representation of the principles of formative assessment that drive improvements in mathematics and science teaching and learning in MPS.

Ten Principles of Formative Assessment (Huinker and Freckman, 2009)

Teacher and Student Articulation of Learning Goals
1. Prior to teaching, teachers study and can articulate the concepts students will be learning.
2. Teachers use student-friendly language to inform students about the objective they are expected to learn during the lesson.
3. Students can describe what mathematical ideas they are learning in the lesson.
4. Teachers can articulate how the lesson is aligned to district learning targets, state standards and classroom assessments and fits within the progression of student learning.

Teacher Focus on Using Assessment Information to Guide Teaching
5. Teachers use classroom assessments that yield accurate information about student learning of concepts and skills and use of processes.
6. Teachers use assessment information to focus and guide teaching and motivate student learning.

Student Focus on Using Assessment Information to Move Learning
7. Feedback given to a student is descriptive, frequent and timely. It provides insight on a current strength and focuses on one facet of learning for revision linked directly to the intended math objective.
8. Students actively and regularly use descriptive feedback to improve the quality of their work.
9. Students study the criteria by which their work will be evaluated by analyzing samples of strong and weak work.
10. Students keep track of their own learning over time (e.g., journals, portfolios) and communicate with others about what they understand and what areas need improvement.

Universal Screener

A universal screener is an assessment tool used for measuring student performance towards district, state and national standards. It identifies students’ growth towards those standards over time. It is usually the first stage within a screening process to identify or predict students who may be at risk for poor learning and behavioral outcomes. Universal screeners are conducted with all students K5-12th grade. The district’s universal screener for mathematics is easyCBM.
Tier 1 (Core Content) and 2 Universal Screener Decision Rules and Cut Scores
MAP/MPG and CPAA

1. Using the ClasStat process, begin by analyzing data from most current Universal Screener (MAP/MPG, PALS and CPAA) to determine which students fall into the lowest 20% at each grade level using the School Dashboard report titled: Universal Screener: Current Student Detail and if needed, NWEA report by grade report.

2. Using the ClasStat process to triangulate most current summative and formative data (including attendance, incident and suspension data when appropriate) to determine if the students in the lowest 20% are:
   - performing at or above National Norms based on beginning, middle or end of the year standards from NWEA. for grade according to the most current screener; or
   - receiving specialized support in the identified area of concern through additional instruction provided by a special education teacher (i.e., a reading and/or math page in the IEP) or receiving a “double dose” or supplemental course in reading and/or math or receiving a replacement curriculum (e.g., Unique or Language!);
     - Determine if an online intervention would provide appropriate, additional support for students with IEP pages addressing the area of concern by having a conversation including the students’ special education teacher.
     - If it is determined that the online program is NOT appropriate, do not consider this student for additional intervention.
   - below proficient, but based on growth, evidenced by formative data, are appropriately responding to core instruction;
   - in need of a behavioral intervention prior to attempting an academic intervention.

Students meeting the above criteria, including all students considered on or above level, could still receive online program skill support with a focus on differentiation at the core. The online resource responds to students’ success at each instructional level, allowing for high performing/high achieving students to accelerate their learning as well. These students would not be identified as Tier 2 intervention students, in which case teachers are not required to add an intervention plan into EXCEED, but rather monitor student progress through online tool generated reports.

3. The remaining students of the identified 20% are then provided intervention in addition to core instruction, in the appropriate intervention either through the online program or in explicit small group instruction. Teachers will:
   - Identify the area/s of concern for each identified students.
   - Follow the same procedures for students with disabilities who may have been identified as benefiting from an additional online intervention.
   - Determine which interventions best serve individual student’s needs based on level set testing and/or survey data.
     - Create the intervention groups based on identified areas of concern (AOC)
     - Develop individual intervention plans for each student in EXCEED®RtI.
   - Provide intervention based on intervention time built into the school’s schedule.
   - Determine who will deliver interventions and conduct progress monitoring.
• Determine who will be in charge of data management:
  o Is progress monitoring happening?
  o Is data being entered into EXCEED®RtI?
• Generate a baseline score by giving each student in Tier 2 interventions an initial assessment, three times, in an identified area of concern. The median score of the three assessments is used as the baseline. Once a baseline score has been established, the next step is to determine an appropriate goal and a specific target to generate an aimline (See RtI Handbook-Appendix B, directions on setting up an easyCBM account for monitoring mathematic progress).

4. Progress Monitoring:
Students who receive daily interventions, their progress monitoring occurs at least bi-weekly. In literacy, teachers record and plot data scores on the progress monitoring booklets and enter scores into EXCEED®RtI. In mathematics, teachers will have students complete the corresponding easyCBM probe online. Teachers must record the student’s score and enter it into EXCEED®RtI The graph generated by the intervention plan and progress monitoring data points in EXCEED will be used to apply the decision-making rules after 3 scores have been recorded. These data points guide the team’s discussion to:
  • Determine the rate of a student's progress
  • Provide information on the effectiveness of instruction and need for modification of the intervention and if necessary
  • Identify the need for additional information, analyze and interpret gaps between aimline and achievement.
  • Use the 3 point rule: examine the last 3 consecutive scores to determine instructional success of the intervention

If student/s demonstrate success with an intervention:
  • Increase the target goal and continue the current intervention
  • Exit students from Tier 2 interventions that have made sufficient progress as determined by grade level expectations on DIBELS Next or IDEL probes and/or the Math easyCBM progress monitoring measure (See Exit Criteria for Tier 2 interventions below)
  • Provide a new intervention to target the next skill level needed to become successful in Tier 1 (Core Content)

5. Tier 2 interventions Exit Criteria:
Use the 3-point rule: examine the last 3 consecutive scores to determine instructional success of the intervention.
  • If all three scores fall below the aim line, make a change to one of the following:
    1. Check if correct area of concern is being addressed
    2. Check the fidelity of instruction
    3. Increase the frequency of the intervention
    4. Increase the amount of time given to the intervention
    5. Ensure the alignment of area of concern and intervention
6. Adjust the instructional materials
7. Move the student to a different group

- If all three scores fall above or are at the aim line:
  1. Check if correct area of concern is being addressed
  2. Move to another intervention, that ensures alignment with the skill deficit, at an increased skill level
  3. Move out of Tier 2 interventions into Tier 1 (Core Content) with continued progress monitoring
  4. Increase the goal

- If neither applies, continue to collect data for the remainder of the intervention until the 3-point rule can be applied.

Students who are **exited from Tier 2 intervention should be monitored** for progress to ensure that they can maintain the skill level without the previously provided support.

**High School Academic Screener System**

Academic screening by the Tier1 Universal Team in grades 9 -12 is a system that is comprised of two sources of data--MAP RIT scores in reading and mathematics along with indicators from SAIL. Below are step-by-step instructions for analyzing the data and identifying students in need of Tier 2 services.

1. Go to your School Leader Dashboard page. Run the “**Universal Screener: Current Student Detail**” report.
2. Sort on MAP Reading RIT column to identify lowest 20% of students when RIT scores are available. (High schools may choose to include additional students based on the school’s capacity to provide intervention courses. The total number of student able to be served should be determined prior to these data discussions).
3. Through a data discussion, determine which of these identified students might not need to be placed in a tier 2 intervention at this time. Remove these students from the potential Tier 2 group.
   - Examine students’ English Language Arts grade point average and credits attained when available from the report. Use these additional data to corroborate identification of lowest performing students. Students who are at low risk in GPA and low risk for credits earned can be removed from the list of potential recipients for Tier 2 services.
4. Examine data from SAIL to determine which students have primary attendance or discipline issues. Assign attendance or behavior interventions for these students. These students may also require academic interventions and should not be automatically excluded from Tier 2 academic interventions. If the team determines that a student should also receive an academic intervention, another meeting will be scheduled to include school administration and programmer to address when the intervention will begin and where it will take place.
5. Identify which students currently receiving intervention services in the area of concern. Remove these students from the list of potential recipients for Tier 2 services.

6. Use other formative data to determine if the student will continue to receive differentiation within Tier 1 (Core Content).

7. The remaining students will be scheduled for Tier 2 interventions.

8. Repeat the process for mathematics, sorting first on the MAP Math RIT score.

**Exit Criteria for High School Tier 2**

In High School, through focused conversations with the Tier 2 team, a student may exit a Tier 2 intervention beginning with the following criteria. Please note, There may be exceptions to these guidelines, use your professional judgment to make adjustments to meet individual student needs.

* NWEA does not provide national norms for 12\textsuperscript{th} grade, therefore, 11\textsuperscript{th} grade norms are referenced.

**Mathematics Tier 2 Interventions**

**Academics-Mathematics**

Tier 2 interventions can be a combination of externally developed programs, as well as a collection of research and/or evidence-based instructional procedures that can be used in Tier 1 (Core Content) differentiation and/or Tier 2 interventions, based on the level and type of student need.

The Tier 2 intervention processes outlined below are aligned to the process used in the Comprehensive Literacy Plan (CLP) and the MPS RtI Handbook. Teachers are expected to implement high-quality Tier 1 (Core Content) instruction based on the CMSP Instructional Design--LESA. Board-adopted universal screeners serve as a starting point to identify students performing in the lowest 20% of a grade level. These data are supplemented by other, child-specific information, including from various summative and formative assessments, to inform the identification of students for Tier 2 interventions.
The resulting, individual student intervention plan will focus on specific areas of concern/need within the grade-level, focus domains articulated in the Common Core State Standards Mathematics (CCSSM) and grounded in the recommendations of the National Mathematics Advisory Panel advisory on the Content of Math Interventions (Doing What Works, 2009). These include: Operations and Algebraic Reasoning in K-2; Number Operations Fractions in grades 3-5; and Proportional Reasoning in grades 6-8 and 9-12 Linear Algebra (www.achievethecore.org). Additional grade-level appropriate emphasis on the development of Number Base Ten concepts across grade levels will be included in Tier 2 interventions as needed. Intervention plans therein will be continuously monitored and revised over time based on student progress, as determined by district-approved progress monitoring tools.

Identification of Tier 2 intervention Students
Universal Screener performance data, which are provided in a variety of formats, will be used to identify the lowest performing students (bottom 20%) in each grade level. These data will be supplemented by other student performance and contextual information to help teachers to identify Intervention Group/s. Although students are identified in each grade level, there are several criteria that need to be considered in order to identify intervention groups for each classroom. Teachers would create Intervention groups no larger than seven students. Students currently receiving special educational support for mathematics through an IEP would not necessarily be involved in an additional math Interventions (Tier2) Group unless a collaborative decision is agreed upon by both the general education teacher and the special education teacher. Students targeted for Interventions Tier 2 intervention will be so indicated in EXCEED®RtI, an internet application for tracking intervention. Further information on identification of students for tiered interventions can be found in Chapter 2 of the RtI Handbook as well as on the RtI Website at http://www5.milwaukee.k12.wi.us/dept/rti/resources

Figure 3 below outlines the steps involved in following a student through the Tier 2 intervention math process.
Figure 3: Tier 2 Interventions Mathematics System K-12

<table>
<thead>
<tr>
<th>Tier 2 interventions Mathematics System K-12</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Grade level teachers administer Universal Screeners –September/January/May.</td>
</tr>
<tr>
<td>2. Grade level teams use the ClassStat process to analyze and discuss Universal Screener data. Teams identify the lowest 20% of the students in each grade level. Other summative and formative data will be analyzed as well to determine if the student should receive a tiered intervention.</td>
</tr>
<tr>
<td>3. Teachers use MAP data Class by RIT report to affirm grade level critical focus area of weakness (Number Process and/or Algebraic Relations) and;</td>
</tr>
<tr>
<td>4. Teachers administer an IFSA ( Intervention Focus Standard Assessment) to identify the specific area of weakness (Domains: K-2 OA and NBT; 3-5 NF and NBT; 6-8 (PR and NBT); 9-12 Linear Algebra.</td>
</tr>
<tr>
<td>5. Teachers discuss and analyze the results to create a focused intervention plan.</td>
</tr>
<tr>
<td>6. Teachers develop an intervention plan in EXCEED®RtI; identifying the area of concern, which progress monitoring tool will be used to measure progress, how often progress monitoring will occur (i.e., every 2 weeks,) when the intervention will occur and the number of minutes (i.e., 10:30 MWF for 20 minutes).</td>
</tr>
<tr>
<td>7. Administer an intervention as defined in the intervention plan.</td>
</tr>
<tr>
<td>8. Teachers administer a progress monitoring CBM and record results.</td>
</tr>
<tr>
<td>9. Record data points into EXCEED®RtI.</td>
</tr>
</tbody>
</table>

Identification of Tier 2 Interventions Student Needs and Appropriate Interventions

Central to the effectiveness of the intervention is the quality (e.g., evidence base) and appropriateness (e.g., aligned to student need and grade-level standard) of the treatment, as well as the fidelity of implementation. Interventions will be constructed/selected around Focus Domains in each grade band as identified by the authors of CCSSM. Additionally, the authors of the SMARTER Balance Assessment consortium have identified high priority standards within each grade band (p. 18-20). To prepare students for the rigor anticipated in the SMARTER Balance Assessment, as well as the focus of the CCSSM in each grade, intervention groups and supports will focus on the development of student understanding of the high priority standards.

Figure 4 is an example of the CMSP RtI Priorities in Mathematics structure in the K-2 grades that will be a part of the MPS Tier 2 interventions model (as defined by the
Priorities in Mathematics from achievethecore.org). A similar structure will be used in 3-5 (Fractions); 6-8 (Ratio and Proportion Relationships) and 9-12 (Linear Algebra).

Figure 4: MPS Tier 2 Interventions Internal Model K-2 Focus

<table>
<thead>
<tr>
<th>MPS Tier 2 Interventions Internal Model: K-2 Focus</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Domain</strong></td>
</tr>
<tr>
<td>Kindergarten</td>
</tr>
<tr>
<td>Operations and Algebraic Thinking</td>
</tr>
<tr>
<td>Number and Operation in Base Ten</td>
</tr>
<tr>
<td>Grade 1</td>
</tr>
<tr>
<td>Number and Operation in Base Ten</td>
</tr>
<tr>
<td>Grade 2</td>
</tr>
<tr>
<td>Number and Operation in Base Ten</td>
</tr>
<tr>
<td>K-2 Grade Band</td>
</tr>
<tr>
<td></td>
</tr>
</tbody>
</table>

The identification of students receiving Tier 2 intervention services and appropriate supports is an on-going process, one that continuously evolves based on student response to the intervention as indicated in measurable progress. Real time progress monitoring tools are therefore essential to effective implementation. Outcome based measures, such as easyCBM, will be used to determine whether or not an intervention is helping the student close the gap in achievement compared to his/her peers.

“As research becomes more important in educational practices, educators face a dilemma: They want to use research-based practices; but, oftentimes, for such research to exist, someone must have assessed the effectiveness of the strategies. High school leaders who want to use Response to Intervention (RtI), also known as tiered instruction, to improve student achievement find themselves in this situation. While high school may find research to guide individual components of their use of tiered intervention, strong evidence identifying exemplary practices for high school RtI is not yet available.” Uncharted Territory: Using Tiered Intervention to Improve High School Performance. (2009). SEDL [www.sedl.org](http://www.sedl.org).

Since there are limited research-based practices to support a Tier 2 intervention structure in high school, Milwaukee Public Schools has identified the CCSSM domain of
Linear Algebra as a focus for high school mathematics Tier 2 interventions. This domain has identified by Achieve the Core [http://achievethecore.org](http://achievethecore.org) as **Priorities in Support of Rich Instruction and Expectations of Fluency and Conceptual Understanding**. Due to the large number of students who attend MPS high schools, there are a significant number of students who qualify for Tier 2 interventions. In order to meet the need of those students, the MPS mathematics department is in the preliminary stages of planning an alternate course option entitled

**9th Grade and 10th Grade Interventions.** These courses would provide students with an intervention of Algebra content. Math Intervention courses would be an opportunity for students to engage in daily mathematics instruction in addition to the core content. Math Investigations courses, provide students additional time with core content. During their class session, students will revisit-foundational mathematical ideas from grades 6-8 related to Linear Algebra (see Figure 5) and applying those ideas to study the content of Algebra 1. This course will span the full academic year (two semesters). The goal is for students to gain enough fluency in those foundational areas as well as develop the ideas of Algebra 1 so that they are able to rejoin the core mathematics sequence with support as required.

**Identifying students**

Students would be identified for enrollment in the Math Intervention and Math Investigation courses by using multiple data points. The first would be to use MAP as the initial universal screener. Other data resources that could be used to consider student eligibility would be: trends in grades from previous mathematics courses and teacher or teacher team recommendations. Because of these various ways to identify student in need of support, this course would not only be for the lowest 20% of students, but could include many more students significantly behind. This would provide an opportunity for students with an IEP in mathematics to be included in a community of learners who are all working to develop foundational ideas.

**Additional online opportunities for Tier 2 intervention support**

In order to support students who require Tier 2 Intervention Services, MPS has purchased Carnegie Mathematics for grades 9-12.
### Figure 5: Common Core Algebra Middle and High School

<table>
<thead>
<tr>
<th>Common Core Algebra</th>
<th>Common Core Algebra Seminar Middle Grades Supporting Standards</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Unit</strong></td>
<td><strong>Standards</strong></td>
</tr>
</tbody>
</table>
| Relationships between Quantities and Reasoning with Expressions and Equations | N-RN3  
N-NQ 1-3  
A-SSE1,2  
A-CED 1-4  
A-REI 1,3 | 6.RP  
Use ratio concepts and use ratio reasoning to solve problems. | 7.RP  
Analyze proportional relationships and use them to solve real-world and mathematical problems. | 8.NS  
Know that there are numbers that are not rational and approximate them by rational numbers. |
|                     |                 | 6.NS  
Apply and extend previous understandings to the system of rational numbers. | | |
|                     |                 | 6.EE  
Apply and extend previous understandings of arithmetic to algebraic expressions. | | |
<p>|                     |                 | Reason about and solve one-variable equations and inequalities. | | |</p>
<table>
<thead>
<tr>
<th>Descriptive Statistics</th>
<th>S-ID 1-9</th>
<th>6.S</th>
<th>Develop understanding of statistical variability.</th>
<th>Summarize and describe distributions</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>7.S</td>
<td>Use random sampling to draw inferences about two populations</td>
<td>Draw informal comparative inferences about two populations</td>
</tr>
<tr>
<td></td>
<td></td>
<td>8.S</td>
<td>Investigate chance processes and develop, use and evaluate probability models.</td>
<td>Investigate patterns of association in bivariate data.</td>
</tr>
<tr>
<td>Linear Functions and Models</td>
<td>F-IF 1-6, 7ab(linear), 9</td>
<td>6.NS</td>
<td>Apply and extend previous understandings of numbers to the system of rational numbers.</td>
<td>7.RP</td>
</tr>
<tr>
<td></td>
<td>F-BF 1ab, 3</td>
<td>7.RP</td>
<td>Analyze proportional relationships and use them to solve real-world and mathematical</td>
<td>8.EE</td>
</tr>
<tr>
<td>Exponential Functions and Models</td>
<td>F-IF 1,3,4,5,8b,9</td>
<td>6.RP</td>
<td>Understand ratio concepts and use ratio reasoning to solve problems.</td>
<td></td>
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<tr>
<td>---------------------------------</td>
<td>------------------</td>
<td>------</td>
<td>------------------------------------------------------------------</td>
<td></td>
</tr>
<tr>
<td></td>
<td>F-BF 1ab,3</td>
<td>7.RP</td>
<td>Analyze proportional relationships and use them to solve real-world problems.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>F-LE 1,2,3,5</td>
<td>8.EE</td>
<td>Work with radical and integer exponents.</td>
<td></td>
</tr>
</tbody>
</table>

6.EE
Represent and analyze quantitative relationships between dependent and independent variables.

7.EE
Use properties of operations to generate expressions.

Solve real-life and mathematical problems using numerical and algebraic expressions and equations.

Analyze and solve linear equations and pairs of simultaneous linear equations.

8.F
Define, evaluate and compare functions.

Use functions to model relationships between quantities.

8.SP
Investigate patterns of association in bivariate data.
| Systems of Linear Equations and Inequalities | 6.EE
Apply and extend previous understandings of arithmetic to algebraic expressions. |
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>A-REI 5, 6, 10-12</td>
<td>mathematical problems.</td>
</tr>
</tbody>
</table>
|                                            | 7.EE
Use properties of operations to generate equivalent expressions. |
|                                            | 8.EE
Analyze and solve linear equations and pairs of simultaneous linear equations. |
|                                            | 8.F
Define, evaluate and compare functions. |
|                                            | Use functions to model relationships between quantities. |

**Interventions**

MPS has a menu of approved, evidence-based Tier 2 interventions for mathematics from which schools and teachers make selections based on the needs of their identified
students (RtI. These interventions can be found on the MPS portal (reference RtI Handbook, Academics - Mathematics p. 70). These interventions will include Explicit Strategic Instruction to develop the areas of concern, for example, number strategies (e.g. counting on, derived facts) and models (e.g. 10 frames, tape diagrams and number lines) to develop fluency. Explicit Strategic Instruction includes using a Student Think Aloud strategy to help students identify the underlying structures of word problems. Systematic use of models to provide students opportunities to verbalize their thinking, by talking, writing or drawing the steps they used to solve a problem are a part of the Think Aloud strategy. Interventions will also include use of the Concrete-Representational-Abstract (CRA) model to support developmental processing of critical math concepts.

As described earlier, teachers would report the use of specific interventions in Exceed RtI and continue to monitor progress so as to determine the effectiveness of the intervention and plan accordingly. All classroom teachers, including those at contracted sites, charters and partnership schools have access to and are expected to document tiered interventions in EXCEED RtI. Exceptions could include contracted sites with alternative compliance plans.

Response to Intervention resources can be accessed from the MPS Portal homepage and The Learning Community (TLC) http://tlc.milwaukee.k12.wi.us/course. This online community contains numerous instructional resources that support online program options and small group lessons. The TLC room is titled, Academic Interventions for 2012-13

Mathematics Tier 3 Intervention
Tier 3 interventions target students with significant skill deficits in specific academic and behavioral areas and eventually students that demonstrate giftedness in specific areas. The goal is to have at any given time, no more than 5% of students needing tier 3 supports during the course of a year. Tier 3 interventions are typically managed by the Tier 3 team which may include members of the IEP team for students already receiving special education services. Parents, and when appropriate community partners, participate in developing plans at the individual student level.

Tier 3 is intensive interventions characterized by their increased focus for students who fail to respond to less intensive forms of instruction. Intensity can be increased through many dimensions including length, frequency, and duration of implementation. With RtI, Tier 3 intensive interventions are sometimes referred to as tertiary intervention.

Response to Intervention: Tier 3 Systems of Support
A student is referred to Tier 3 when his/her progress is far below expectations as compared to his or her peers or when a significant level of individualized planning is required. This can occur when Tier 2 interventions have not proven to be effective based on progress monitoring data, universal screener data and other classroom formative data, or if a student is at least 2 years delayed according to grade level benchmark goals and the team determines a tier 3 intensive intervention would be most appropriate. These interventions will take place daily and for a significantly more amount of time in addition to required core instruction time with a group size no larger than 3 students.*
The Tier 3 Team will gather additional diagnostic assessments to determine specific need/s for intervention. If student continues to demonstrate a lack of expected progress after 6 weeks of daily intervention, the next step could include a request for a special education evaluation.

*Exception will be a replacement curriculum (e.g., Language!).

Tier 3 team adds intensive services in addition to the core instructional program delivered within Tier 1 (core content). School teams, containing specialists develop individualized plans for students. Staffs use the resources and skills available within the school building to determine which intensive services are most appropriate. The Educational Wraparound Service will be the format for most Tier 3 referrals.

Refer to RtI handbook Chapter 5 for additional information regarding Tier 3 Intervention.

**Standards-based Grading and Reporting**

In MPS, each school has historically created its own report card in the MPS student information system (eSIS). More than two years ago, in response to growing requests from schools for guidance as to what should be included in these report cards, the Administration began developing model report cards with schools. Over time, this process evolved into one increasingly focused on creating common, standards-based report cards for eventual use by all PreK-8 schools and grades.

Standards-based grading is considered a high-leverage strategy for better aligning classroom instruction and assessment practices, as well as performance feedback to students and families, to consistent, rigorous, grade-level standards. Note, a standards-based report card is only one component of such a standards-aligned system. (Regular, standards-based assessment and grading in classrooms, while likely to have even greater impact than the report card alone, is more complicated and will require both more time and support to implement with fidelity and at scale. This will be an on-going effort.)

**Rationale**

Standards describe what a student should know and be able to do at each grade level in all subjects. A standards-based report card is designed to give more and better information about how a child is progressing. First, it helps to make sure there is more consistency of expectations in every district classroom. It helps teachers, students and parents focus on the standards from the very beginning of the school year, giving students the opportunity to get help earlier if they are not making adequate progress. Standards-based grading separates teacher feedback on nonacademic factors such as behavior, attendance and compliance from academic performance. Finally and perhaps most importantly, all stakeholders will know exactly how a child is doing based on the standards. It makes clear which big ideas and concepts a child has learned and also what work still needs to be done to make sure every child is ready for the next grade level.
One of the major differences in standards-based reporting is the replacement of traditional grades with performance levels on standards. This new report card will ensure a clear and consistent, district wide reporting format across schools and grades and helps MPS to better communicate with parents and students about progress relative to grade level standards. It identifies students’ levels of progress with regard to those standards, areas of strength and areas where additional time and effort are needed to meet expectations at this particular point in the school year. This means that, instead of students earning a single grade (e.g. A – F) in a subject like mathematics and science, they will receive more detailed feedback on their work from classroom assessments and other performance-based projects on specific topics like geometry, statistics and probability, or life sciences and engineering and technology. Grades would reflect student performance on the common, grade-level standard (e.g., AD: Advanced, exceeding grade level expectations, PR: Proficient, meeting grade level expectations, BA: Basic, just below grade level expectations, MI: Minimal, far below grade level expectations) as opposed to a letter grade and effort would be reported separately.

Student performance will be reported as minimal, basic, proficient, or advanced in each of the areas taught and assessed during a marking period. This change also clarifies grading practices for students with disabilities whose instruction targets regular grade level standards; these students will be taught with accommodations to meet the same rigorous grade-level standards as their regular education peers. For students whose instruction addresses the alternate grade band standards per their Individualized Educational Plan (IEP), they will meet modified grade band extended standards with multiple opportunities to join their grade level peers in classroom experiences and assessments when appropriate.

Aligning classroom instruction, assessment and feedback to students and families to rigorous standards is essential to improving teaching and learning. This is particularly true as we begin to roll out new, more challenging Common Core State Standards. And though the revised, PreK-8 district report card is only one component in this effort, it has considerable potential. Other efforts include (classroom assessments based on standards CABS), student and parent conferences and MAP universal screener/benchmark assessments to support more differentiated instruction and identify students for targeted supports (e.g. Tier 2 interventions). Each of these creates an opportunity for individual and groups of teachers to reflect on student learning and their own practice and use meaningful, standards-specific feedback to empower students and engage families in monitoring student progress and improving learning.
SECTION II: DISCIPLINE-SPECIFIC INFORMATION

MATHEMATICS CURRICULUM, INSTRUCTION AND ASSESSMENT

Mathematical literacy is an individual’s capacity to identify and understand the role that mathematics plays in the world, to make well-founded judgments and to engage in mathematics, in ways that meet the needs of that individual’s life as a constructive, concerned and reflective citizen. (OECD PISA, 2001)

Standards and Research-based Curriculum

Common Core State Standards in Mathematics

The Common Core State Standards (CCSS) are an attempt to introduce consistency across states in what is expected in teaching and learning of mathematics, especially in the grade-level placement of individual topics. There are two distinct components to these standards: Standards for Mathematical Practice and Standards for Mathematical Content.

The Standards for Mathematical Practices are important processes and proficiencies that describe ways students engage in mathematics. These are the CCSS version of the National Council of Teachers of Mathematics (NCTM) process standards, or of Wisconsin's Mathematical Processes (the former Wisconsin Standard A). These practices are the heart and soul of the CCSS. The Standards for Mathematical Practices include:

- Make sense of problems and persevere in solving them
- Reason abstractly and quantitatively
- Construct viable arguments and critique the reason of others
- Model with mathematics
- Use appropriate tools strategically
- Attend to precision
- Look for and make use of structure
- Look for and express regularity in repeated reasoning

It is important to note that the Standards for Mathematical Practice are not just listed as “Practices” but as “The Standards for Mathematical Practice.” When the State adopted the Common Core State Standards for Mathematics, the Standards for Mathematical Practice were also adopted. The Standards for Mathematical Practice must become a reality in Milwaukee classrooms. They are descriptors of what a mathematically proficient student does. Curriculum, instruction and assessment should be intentionally focused on developing these practices along with the Standards for Mathematical Content.

The Standards for Mathematical Content in grades K-8 identify several mathematical content domains, each of which cross several grades and contain one or more clusters of standards at each grade level. Since it is not practical to list high school content by grade level, the Standards for Mathematical Content in high school are organized into
conceptual categories, which play a similar role to the K-8 content domains. The two pieces of the CCSS document are very similar to the prior Wisconsin Assessment Framework components of Mathematical Processes and Mathematical Content. MPS teachers should be very familiar with the importance of both of these components.

Curriculum
While textbooks alone should never be understood as curriculum, this is especially true in MPS, which has a variety of approved K-12 mathematics texts. To ensure a common, high quality, CCSS aligned curriculum at each grade level, MPS is developing a variety of curriculum resources, including curriculum and pacing guides across all adopted materials. The Mathematics Curriculum Guides are based on the Common Core State Standards and outline what students should understand and be able to do in their study of mathematics. Asking a student to understand something means asking a teacher to assess whether the student has understood it. According to NCTM, a curriculum is more than a collection of activities; it must be coherent, focused on important mathematics and well articulated across the grades. A coherent curriculum effectively organizes and integrates important mathematical ideas so that students can see how the ideas build on or connect with other ideas, thus enabling students to learn with understanding, develop skill proficiency and solve problems. The curriculum guides will support teachers’ ability to emphasize depth over breadth and focus on the essential ideas and processes of mathematics. In essence, the curriculum guides will provide a road map that helps teachers guide students to increasing levels of sophistication and depths of knowledge. The guides also provide misconceptions that teachers should consider when lesson planning.

Pacing guides have been developed for mathematics and are based on the Common Core State Standards. The pacing guides will be helpful in planning curriculum for the year in order to include all of the necessary material for meeting the standards. The guides help coordinate teaching efforts district wide. Should students move from one school to another in the district, they can be assured of receiving consistent quality of instruction and curriculum. Pacing guides are a tool to help concentrate time, effort and resources to maximize student learning. See Section III for specific examples of district-developed curriculum and pacing guides.

Engaging Materials and Resources
In recent years, national attention has focused on the use and role of instructional materials in mathematics education to improve student achievement. Instructional materials play a central role in helping students to achieve the standards. The acquisition of the Mathematical Practice Standards is intrinsically entwined in the learning, the doing and the understanding of a particular portion of the mathematics content. Therefore, Mathematics Practice Standards are to be addressed, not in isolation, but by and through the presentation of content listed under the other standards. Instructional materials should support strategies that will be effective for all students and must specifically address the needs of teachers who instruct a diverse student population. Materials selected should include research-based pedagogical approaches that give teachers effective alternatives in teaching mathematics. Every student needs
and deserves a rich and rigorous mathematics curriculum that is focused on the development of concepts, the acquisition of basic and advanced skills and the integration of problem-solving experiences. The goal is to provide challenging mathematics opportunities to foster the growth of intelligent, thoughtful and mathematically literate members of society.

The list represents the textbooks that are currently being used by the majority, though not all of MPS schools. Prior MPS textbook adoptions allowed for greater autonomy at the school level in the selection of instructional materials, as evidenced in the detailed list of textbooks used by each school. (Common, K-12 district wide math textbook adoptions are planned in future years, contingent on the availability of CCSS-aligned materials and budget.) Despite the diversity of materials currently in use, MPS is committed to ensuring a common core curriculum across schools.

CMSP implementation with fidelity requires that all schools make purposeful use of district-developed curriculum and pacing guides, common course plans and aligned assessments to ensure instruction that is aligned to the Common Core State Standards and common scope, sequence and pacing across the district. Formal monitoring of fidelity of implementation includes specific attention to such compliance. (Note: Some contracted schools have an alternative compliance plan to the CMSP framework. These plans are based on meeting specific criteria as outlined by the district.)

To support meaningful problem-solving activities and improved differentiated instruction, classrooms will have regular access to manipulatives. Manipulatives are concrete objects that are commonly used in teaching mathematics. In teaching basic operations involving whole numbers, it is important to use objects that are uniform and that accurately represent base-ten relationships. Base-ten blocks, two-colored counters, fraction strips, beans and geometric solids are a few of the many commercially available and teacher-made manipulatives that students might use while in grades K-5. Manipulatives have been used over the years at the primary and early elementary grades; however, as students progress through their later elementary grades through high school it is important for instructional materials to continue including manipulatives. The National Council of Teachers of Mathematics (NCTM) Principles and Standards for School Mathematics emphasizes the importance of using manipulatives and visual representations as well as mathematical modeling in each of its standards at all grades levels.

Mathematics has many areas, patterns, measurement, geometry, statistics and probability that they are often abstract to students. We need to help children develop the ability and confidence to find their way around in each of these areas, see how they connect and know what to do should they forget a fact or procedure. Manipulatives help make abstract ideas concrete and give students ways to construct physical models of abstract mathematical ideas. We want students to become comfortable and proficient with the language of mathematics and manipulatives help them construct an understanding of ideas that they can then connect to mathematical vocabulary and symbols. Manipulatives intrigue and motivate while helping students learn.
Manipulatives such as buttons, dried beans, cubes and animal counters will help our students develop a rich understanding of number which forms the basis for counting, arithmetic and real-world applications. Sets of attribute logic blocks with their different shapes and colors are effective for classifying, sorting and ordering. Base ten blocks, Cuisenaire rods, Unifix cubes and money can be used to help children learn a wide range of number concepts including place value, addition, subtraction and multiplication. By building number combinations with these materials, children are helped to understand the logic of the concept of carrying or borrowing or regrouping as used in the paper-and-pencil computations for addition and subtraction. As the work of the CMSP becomes more transparent and parents increasingly are engaged, they are expected to practice and reinforce these same strategies at home. See Section IV, Parental Engagement.

**Rigorous and Meaningful Instruction**

To learn the mathematics required for today’s world, students need adequate time to study and learn mathematics in school. Every student should study mathematics every year through high school, progressing to a more advanced level each year. All students need to engage in learning challenging mathematics for at least one hour a day at the elementary, middle school and high school levels. Class time should be planned effectively to engage all students. Learning important mathematics cannot be rushed and students need time to process what they are learning (Pezdek and Micheli, 1982).

At every grade level, students must have time to become engaged in mathematics that promotes reasoning and fosters communication between teachers and students and among students. Students need time to develop and practice skills and procedures for solving a wide range of problems at all levels of instruction, interruptions to classes should be held to a minimum.

Making Danielson’s framework a reality and putting NCTM's criteria into action in MPS schools and classrooms requires a clear, consistent, evidence-based approach to the design of instruction. As Hensee charges, effective math instruction must learn from the experience of improvement efforts in literacy and be more explicitly guided by research and theory on teaching and learning in the disciplines to develop specifications to ensure the quality of instruction.

“Literacy workshops were designed by educators to maximize the use of elements that many teachers intuitively knew-and research had confirmed-helped students learn better. It is time for us to bring our best literacy teaching techniques, lessons learned from our personal experiences and results from research into math [and science] instruction” (D. Hensee, “Reworking the Workshop” 2002).

**Instructional Design**

Launch-Explore-Summarize-Apply (LESA) is a balanced approach. It provides various ways to teach students by using differentiated learning strategies and providing activities to meet the needs of all learners. This model looks at instruction in three phases.
- **Launch:** Lessons begin with a full-class discussion of a problem situation and of related questions to think about. This discussion sets the context for the student work to follow and helps to generate student interest; it also provides an opportunity for the teacher to assess student knowledge and to clarify directions for the group activities.

- **Explore:** Classroom activity then shifts to investigating focused problems and questions related to the launching situation by gathering data, looking for patterns, constructing models and meanings and making and verifying conjectures. As students collaborate in small groups, the teacher circulates from group to group providing guidance and support, clarifying or asking questions, giving hints, providing encouragement and drawing group members into the discussion to help groups work more cooperatively. The unit materials and related questions posed by students drive the learning.

- **Summarize:** A full-class discussion of concepts and methods developed by different small groups then provides an opportunity to share progress and thinking. This discussion leads to a class summary of important ideas or to further exploration of a topic if competing perspectives remain. Varying approaches and differing conclusions that can be justified should be encouraged.

- **Apply:** The math block ends with students being provided the opportunity to practice what they have learned. They extend the use of skills and concepts and make connections to other learning. Students are given a task related to lesson objectives to complete on their own, with a partner or in small groups.

As suggested earlier, effective instructional design requires careful and continuous attention to differentiation to meet the needs of all learners. In the LESA model, this occurs at each stage, in scaffolding (e.g., connecting to prior knowledge) in the Launch, in the kinds of activities and materials used in Explore and often in both Summarize and Apply. The graphic below serves as a resource in planning for such differentiation.
Instructional Time
For teachers to be effective and all students to learn the mathematics required for success in the 21\textsuperscript{st} century, students need adequate time to study and learn mathematics in school. Every student should study mathematics every year through high school, progressing to a more advanced level each year. All students need to engage in learning challenging mathematics concepts and skills for at least one hour a day at the elementary and middle school levels.

Class time should be planned effectively to engage all students. Learning important mathematics cannot be rushed and students need time to process what they are learning (Pezdek and Micheli, 1982). At every grade level, students must have time to become engaged in mathematics that promotes reasoning and fosters communication between teachers and students and among students. Students need time to develop and practice skills and procedures for solving a wide range of problems. Most important, developing the concepts and skills that ensure success in school and beyond requires a substantial investment of time from both the teacher and the student. At all levels of instruction, interruptions to classes should be held to a minimum. Learning experiences should be carefully planned to engage all students in meaningful mathematics learning each day of the school year.
Lesson Planning Template
The Instructional Design Lesson Planning Template is provided for classroom teachers, coaches and school leaders to support the implementation of the Mathematics Instructional Design. The template is meant to support fidelity to the Launch-Explore-Summarize-Apply model and the continuous improvement in the mathematics teaching and learning for all students. The tool is meant as a planning guide with crucial points to consider including the:

- mathematics to develop during the lesson;
- alignment to the Common Core State Standards for Mathematics;
- formative assessment principles and use of learning intentions and success criteria with students; and
- instructional design, e.g., Launch-Explore-Summarize-Apply.

Math Instructional Design – Tier 1 (Core Content)
Purpose: High-performing districts and schools adopt high, common expectations for what children should know and be able to do, develop a shared vision of effective instruction, align resources (e.g., curriculum, assessments, professional development) and systems (e.g., support and accountability) and build professional learning communities (e.g., peer observations, coaching supports, student-focused conversations, feedback) around these. Consistent with this approach, the following “reminders” or “look-fors” are provided for classroom teachers, coaches and school leaders to support implementation of the Comprehensive Mathematics and Science Plan (CMSP) with fidelity and support continuous improvement in mathematics teaching and learning for all students. Educators are encouraged to use this tool to guide informal observations and discussions of classroom implementation of the CMSP and four domains of effective teaching—planning and preparation, classroom environment, instruction and professional responsibilities.

The following outline of Launch-Explore-Summarize-Apply is not meant to serve as an evaluation tool or a checklist. It recognizes that teaching is a complex task that requires teachers who are skilled at matching learning objectives, student learning needs, instructional/curricular resources and best practices to ensure that all children achieve to high standards. As such, the look of classrooms effectively implementing the CMSP will be diverse. Likewise, the type and intensity of support teachers and school communities need differ.
**LAUNCH**

**Elicit and Engage**

<table>
<thead>
<tr>
<th>Purpose:</th>
</tr>
</thead>
<tbody>
<tr>
<td>• To capture the learner’s attention</td>
</tr>
<tr>
<td>• To activate prior knowledge</td>
</tr>
<tr>
<td>• To stimulate, not stymie thinking</td>
</tr>
<tr>
<td>• Connect to past math experience</td>
</tr>
</tbody>
</table>

In the first phase the teacher launches the problem with the whole class. This involves helping students understand the problem setting, the mathematical context and the challenge. The launch phase is also the time when the teacher introduces new ideas, clarifies definitions, reviews old concepts and connects the problem to past experiences of the students. It is critical that while giving a clear picture of what is expected the teacher leaves the potential of the task intact. The teacher must be careful to not tell too much and consequently lower the challenge of the task to something routine, or to cut off the rich array of strategies that may evolve from a more open launch of the problem.

Questions to consider when planning this phrase:

• What prior knowledge do my students need?
• What do the students need to know to understand the story and the challenge of the problem?
• What difficulties can I foresee?
• How can I keep from giving away too much of the problem?
• How can I connect the launch to life experiences to previous knowledge?

Launch the lesson by telling the students they have to build a rectangular pool with a space of 12 square yards. Have the students use tiles and work with a partner to find all the rectangles made from 12 squares. Ask: (1) What are all the possible ways the owner can arrange the squares to make a rectangle (2) How are the rectangles you found and the factors of 12 related? (3) What are all the factors of 12 in order from least to greatest?

**EXPLORE**

**Explore**

<table>
<thead>
<tr>
<th>Purpose:</th>
</tr>
</thead>
<tbody>
<tr>
<td>• To have students become actively involved with the problem, skill or concept</td>
</tr>
<tr>
<td>• To have students look for patterns and investigate</td>
</tr>
</tbody>
</table>

The nature of the problem suggests whether the students work in small groups, partners, individually and occasionally whole class to solve the problem during the explore phase. As students work, they gather data, share ideas, look for patterns, make conjectures and develop problem-solving strategies. The teacher’s role in this phase is to move about in the classroom, observing individual performance and encouraging on task behavior. The teacher helps student persevere in their work by asking appropriate questions and providing confirmation and redirection where needed. For students who are interested in and capable of deeper investigation the teacher may provide extra questions.
different strategies
• To have students record and organize the work and thinking that is done related to the problem. The explore part of the instruction is an appropriate place to attend to differentiated learning.
Questions to consider when planning this phase:
• How will I organize the students to explore this problem? (Individuals? Groups? Pairs?)
• What materials will students need to encourage diverse thinking and problem solving?
• What different strategies might I anticipate students using to explore the problem?

What kinds of questions can I ask:
• To promote discourse at a student-to-student level? Conversation, thinking, learning, etc.?
• To activate background knowledge?
• To push their thinking forward when they become frustrated or off task?
• To summarize their findings?
• To challenge students beyond their current level of thinking?

Challenge the class to find all the rectangles for the numbers 1 to 30. Divide the class into groups of 3 to 4 and assign a few numbers to each group. Each group makes a display for each of their numbers.

<table>
<thead>
<tr>
<th>SUMMARIZE</th>
<th>Explain and Elaborate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Purpose:</td>
<td>The teacher guides the students to reach the mathematical goals of the problem and connect their new understanding to prior mathematical goals and problems. When most students gathered sufficient data or made significant progress in solving the problem they may present and discuss their solutions. Their discussions should include the strategies they used to approach the problem, organize the data and find the solution. During the discussion the teacher helps students enhance the conceptual understanding of the mathematics and guides in refining their strategies.</td>
</tr>
<tr>
<td></td>
<td>Teachers need to solidify what has been discussed in the lesson by clearly summarizing key points after students have shared a variety of strategies used. This is where the main teaching occurs. Bring groups back together and have students explain their solutions. The teacher’s role is to guide students to the big ideas, to make sure that they have nailed the mathematics. Part of the purpose of the Summarize segment is to allow you to assess how well your students are progressing toward the goals of the lesson. Use the discussion to help you determine whether additional teaching and/or additional exploration by students is needed before they go on to the next lessons.</td>
</tr>
</tbody>
</table>
Questions to consider when planning this phase:
- How can I help the students make sense of and appreciate the variety of methods that may be used?
- How can I orchestrate the discussion so the students summarize their thinking in the problem?
- What mathematics, including strategies needs to be emphasized?
- What connections and extensions can be made?
- What rules can we generalize?
- What will I do to follow up, practice or apply the ideas after the summary?
- What ideas do not need closure at this time?

Discuss with the class the patterns that students have found. Ask: (1) Which numbers have the fewest rectangles? (2) Which numbers are square numbers? (3) Do greater numbers always have more factors than lesser numbers?

### APPLY

**Purpose:**
- To practice what students learn
- To extend the use of skills and concepts learned
- To make connections to other learning

**Evaluate and Extend**

If it is appropriate, the summary can end by posing a problem or two that checks students’ understanding of the mathematical goal(s) that have been developed at this point in time. Many classroom activities can be designed to be completed by students working together collaboratively. Students are given a task related to lesson objectives. The teacher circulates in the room assessing levels of student understanding and keeping careful watch on their student’s progress through the task that is closely linked to the instruction.

Questions to consider when planning this phase:
- Where might you use…?
- How does this relate to…?
- What would happen if…?
- What definitions or strategies do we need to generalize?
- What connections and extensions can be made?
- What new questions might arise and how do I handle them?
- What can I do to follow up, practice, or apply the ideas after the summary?

Laurie has chosen a mystery number. Her number is greater than 12 and less than 40 and it has exactly three factors. What might her number be? Use the display of rectangles for the numbers 1 to 30 to help you find Laurie’s number. You may also need to think about what the displays for the numbers 31 to 40 would look like.
Standards-Based Assessments
As described earlier, student achievement is best assessed using a variety of assessment instruments. Effective teachers use a variety of classroom assessment approaches (e.g., observation, student work samples, tests) in conjunction with standard assessment instruments to inform instruction. Observation of students engaged in instructional activities is highly recommended as a way to assess students’ skills as well as attitudes toward learning. The nature of the questions posed by students provides important evidence of their understanding of mathematics. While the following focuses on the important role of formative assessment in improving teaching and learning in mathematics, it is important to note that in MPS, teachers of mathematics have access to a variety of additional student performance data, including, but not limited to the annual state standardized assessment (WKCE-CRT), universal screener data three-times-a-year, ACT and Advanced Placement exam data (for high school students) and course grades. As the district advances its implementation of the new, PreK-8, standards-based report card (described earlier), this promises to become an increasingly valuable resource for students, teachers and parents and families.

Formative Assessment
MPS, through work with the Milwaukee Mathematics Partnership (MMP), has been moving the district toward effective implementation of formative assessment in mathematics. The process began by developing district learning targets based on state standards for student learning and then created classroom assessments (i.e., constructed response items) aligned to the targets. Next, MPS created a protocol for collaboratively looking at student work from these assessments (Bedford, Hollinger, & Huinker, 2006). This was followed by the creation of district curriculum guides that showed the alignment of the learning targets to the curricular materials (i.e., textbooks) to the classroom assessments and that suggested a pacing schedule for the school year. This provided some organization and suggestions to guide implementation of the mathematics curriculum, but the focus was still more at the level of the district or the school, not the classroom nor the students. Teachers still wondered what to do with the classroom assessments: When to give them? Should they be scored? How to use the results? It appeared that the classroom assessments were too often being used as summative measures of student learning, rather than as formative information to guide daily instructional decisions and move student learning. Greater understanding and more guidance on formative assessment was needed.

As a result, the MMP team turned the work of Paul Black and Dylan Wiliam (see Black & Wiliam, 1998; Black, Harrison, Lee, Marshall, & Wiliam, 2003, 2004), Rick Stiggins and colleagues (Chappuis, Stiggins, Arter, & Chappuis, 2005; Stiggins, 2006; Stiggins, Arter, Chappuis, & Chappuis, 2004) and Shirley Clarke (2001). This reflective process revealed that district efforts up to that point had mainly emphasized only two principles of formative assessment. The team was struck by the fact that its perspective had been so narrow and realized more intentional and specific work in providing a structure of principles that would support Assessment for Learning was needed. Building from the work of Stiggins and colleagues (Chappuis et al., 2005), their list of principles was modified in a list of ten principles of formative assessment in mathematics. MPS is now
unpacking these principles in district-wide professional development and assisting teachers in linking them to classroom practice. In many ways, we feel like our journey has just begun, even though we have been involved in this work for several years. In the past, we dabbled at the periphery of assessment practices, mainly increasing our use of constructed response items and wondering what to do with the results. Now that we are using these principles as a framework, we are centered on the classroom and students and the interactions of teachers and students.

Types of formative assessments and formative assessment strategies include:

- Classroom Assessments Based on Standards (CABS)
- Constructed Response Items
- Observational Checklists and Anecdotal notes
- Classroom Discussions
- Classroom Observations
- Mathematics Journals
- Student Portfolios
- Daily Learning Intentions and Success Criteria
- Exit Cards
- Effective use of Questioning
- Graphic Organizer

**Standards-based Report Card (K3-8)**

Clear and common report cards across K-8 schools in MPS (in development) specify what children should know and be able to do at each grade level. Of note, in mathematics, teachers will assess and report students' proficiency levels on the domains of the Common Core State Standards, as described below.

Table 4: K3-8 Standards-based Report Card (standards to be reported)
<table>
<thead>
<tr>
<th></th>
<th>Common Core State Standards Reported</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>K5</strong> Mathematical Practices: behaviors needed to do mathematics successfully</td>
<td>Counting and Cardinality-count to tell the number of objects</td>
</tr>
<tr>
<td>1</td>
<td>Mathematical Practices: behaviors needed to do mathematics successfully</td>
</tr>
<tr>
<td>2</td>
<td>Mathematical Practices: behaviors needed to do mathematics successfully</td>
</tr>
<tr>
<td>3</td>
<td>Mathematical Practices: behaviors needed to do mathematics successfully</td>
</tr>
<tr>
<td>4</td>
<td>Mathematical Practices: behaviors needed to do mathematics successfully</td>
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<td>Mathematical Practices: behaviors needed to do mathematics successfully</td>
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<td>8</td>
<td>Mathematical Practices: behaviors needed to do mathematics successfully</td>
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SCIENCE CURRICULUM, INSTRUCTION AND ASSESSMENT

The following details the aspects of the CMSP Conceptual Framework as each applies to science education.

Common Core Standards and Research-based Curriculum

Next Generation Science Framework and Standards

Several prominent national organizations—The National Research Council (NRC), Achieve, the American Association for the Advancement of Science and the National Science Teachers Association (NSTA) are currently working through a two-step process to develop the Next Generation Science Standards. The first step in the process began with the development of the Framework for K-12 Science Education. The Framework, grounded in current research on science and science learning, identifies the science all K–12 students should know. The framework was developed by nationally and internationally known experts, including practicing scientists, two Nobel laureates, cognitive scientists, science education researchers and policy experts. They were supported by four design teams—in physical science, life science, earth/space science and engineering—and public input. A public draft was released in July of 2010. The NRC reviewed comments and considered all feedback prior to releasing the final Framework on July 19, 2011.

In a process managed by Achieve, 26 states are now leading the development of rigorous, internationally benchmarked and content/practice-rich science standards derived directly from the Framework. The Next Generation Science Standards (NGSS) are being developed through collaboration between these states and other stakeholders in science, science education, higher education and industry along with experts in cognitive, life, Earth/space and physical sciences and engineering. (http://www.achieve.org/files/NextGenerationScienceStandardsFactSheet.pdf, September 2011). Additional review and guidance will be provided by advisory committees made up of nationally recognized leaders in science and science education and business and industry. Also to inform the development of the NGSS, the standards will undergo multiple reviews from many stakeholders including two public drafts. The outcome of the process is to produce a set of high quality, college- and career-ready K-12 Next Generation Science Standards for state adoption.

The Next Generation Science Framework identifies the scope and nature of the education in science and engineering needed in the 21st Century. The framework describes the major scientific ideas and practices that every student should be familiar with by the time they finish high school. It incorporates engineering and technology to highlight the need to better integrate the teaching and learning of science, technology, engineering and mathematics. It provides a description of the science content and sequenced articulation for student learning and skill development in science by grade bands, K-2, 3-5, 6-8 and 9-12.
The Next Generation Science Framework uses the term “practices” to emphasize that engaging in inquiry requires the simultaneous coordination of both knowledge and skills and that inquiry goes beyond engagement of students in experimentation or hands-on activities. The word “practices” is used to clarify the many different ways “inquiry” is interpreted across the science education community by specifying the practices scientists and engineers use to do their work. These practices include asking questions, modeling, devising testable hypotheses, collecting, analyzing and interpreting data, constructing explanations and critiquing arguments, communicating and interpreting scientific and technical texts and applying and using scientific knowledge—several of the same practices used in mathematics (Bybee, 2010 and 2011).

<table>
<thead>
<tr>
<th>Science and Engineering Practices</th>
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<tbody>
<tr>
<td>1. Asking questions</td>
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<tr>
<td>2. Developing and using models</td>
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<tr>
<td>3. Planning and carrying out investigations</td>
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<tr>
<td>4. Analyzing and interpreting data</td>
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<tr>
<td>5. Using mathematical and computational thinking</td>
</tr>
<tr>
<td>6. Construction explanations and designing solutions</td>
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<tr>
<td>7. Engaging in arguments from evidence</td>
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<td>8. Obtaining, evaluating and communicating information</td>
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Curriculum
The MPS science curriculum details what our students will understand and be able to do as a result of instruction. According to the National Research Council (NRC) and the American Association for the Advancement of Science (AAAS), the organization of science curriculum should reflect four qualities. It must be:

- Comprehensive, including the content areas of scientific inquiry, life science, physical science, earth and space science, science, technology and society and the history and nature of science. (NRC, 1996)
- Rigorous, so that students are appropriately challenged and can understand and apply knowledge of a broad range of science concepts and scientific thinking. (NRC, 1996)
- Vertically integrated/articulated, so that each grade’s content builds on the previous learning and prepares students for future studies (AAAS, 1999, 2007)
- Research-based, so that content is presented in a learning progression, with attention to appropriately increasing levels of abstraction and common misconceptions. (NRC 2007)

The Science Curriculum Guides of the CMSP are based on these qualities and built around the Next Generation Science Framework that describes the “big ideas” in science to focus instruction. The framework and the guides were developed so that teachers’ instruction rely less on their students knowing scientific facts and information and more on their students understanding scientific concepts and developing abilities of inquiry. The guides are organized by the three science disciplines identified in the Framework—
the Life Sciences, Physical Sciences and Earth and Space Sciences as well as the corresponding *Core Ideas* and is structured by grade bands, K-2, 3-5, 6-8 and 9-12.

The Next Generation Science Framework focuses on three dimensions for science learning. These dimensions, (1) developing understanding of disciplinary ideas, (2) interrelating cross-cutting concepts and (3) identifying and using science and engineering practices, are woven throughout the grade band curriculum guides. The standards, content, instructional practices and assessments found in these curriculum guides integrate these three dimensions into the teaching and learning processes teachers will use. The guides are intended to provide students with an understanding of science as a way of knowing that supports their development of science content knowledge, of the practices for applying and expanding that knowledge and of the relationships of science to engineering practices.

The development of the MPS PreK-12 science curriculum and pacing guides is our attempt to implement a common science curriculum across all schools with the emphasis on instruction in the science classroom for learning science to make informed decisions and solve dilemmas, not on learning science for knowing a discrete set of facts. The guides are intended to develop coherence among the science concepts within a grade and from grade to grade and to assist teachers of science make decisions about instruction before teaching students. The guides also serve to support the teachers’ planning and preparation domain described in Danielson’s Framework for Teaching (2007) where teachers demonstrate knowledge of resources, design coherent instruction and assess student learning by identifying a variety of resources to “get at” the core ideas.

The components of the curriculum guides include:

- Core Ideas
- Essential/Enduring Understandings
- Common Preconceptions/Misconceptions/Challenges
- Instructional Practices
- Differentiation
- Assessment (Formative and Summative)
- Mathematics Connections
- Literacy Connections
- Academic Vocabulary
- Literacy Resources
- Engineering and Technology Connections
- Scientific Tools
- Resources (including Instructional Technology, Community Connections, ESL)
Science pacing guides are also developed based on the Core Ideas of the Framework by grade level. The pacing guides recommend how to schedule instructional time for each of the disciplines of science by providing timelines for instruction. The components of the pacing guides include:

- Time Frames (by week and/or month)
- Core Ideas (and standards when available)
- Program Materials (district adopted textbook/instructional materials)
- Lessons
- Formative and Summative Assessments

While extensive, the guides are not intended to be exhaustive and all encompassing. Science teachers and other instructional leaders should use their professional judgment to modify and build on the guide to best serve their students. The science curriculum and pacing guides are available on the MPS portal.

**Engaging Materials and Resources**

According to the National Science Teachers Association (NSTA) (2010) learning to think scientifically and understand science concepts requires that students actively participate in observing and manipulating elements of the natural world, investigating cause and effect, engaging in scientific, mathematical and engineering practices and having conversations with other investigators. To support this kind of learning environment, adequate facilities, equipment and tools and appropriate instructional materials are necessary.

To enact the curriculum described earlier, teachers need high quality instructional materials to support planning and present appropriate instruction. Correspondingly, students need engaging science materials and resources to enable them to observe and interact with scientific phenomena and artifacts. It is the intention of MPS to select instructional materials and resources in science in the upcoming years that align with the Next Generation Science Framework and Standards. A list of the current district-adopted textbooks, instructional materials and supplemental resources is included in the Appendices. The district has also committed additional resources to the purchase of supplemental materials for use by students with disabilities so that they may remain in the least restrictive environment for science instruction.

Research into effective science instruction shows that using a variety of methods and balancing hands-on and inquiry/laboratory instruction with direct instruction is the best approach to help students learn science (Banilower et. al, 2008, Tweed, 2009). Hands-on activities tend to engage students, but inquiry engages students with the materials and cognitively with the science concepts, so it is important that both strategies are incorporated in instruction. Additionally, science kits and activities used in science classrooms must explicitly connect to the learning goals so that students understand the purpose of the instruction.
In MPS science classrooms, basic classroom facilities should include water, space for materials and flat surfaces that allow students to explore. In more advanced classes, basic facilities should also include adequate electric and gas outlets, sinks and fume hoods. The classrooms should be arranged at all grade levels to allow for transitions between whole and small group instruction, demonstrations and presentations and individual work. Storage facilities should also be available to maintain a safe and accessible inventory of materials. Safety procedures and necessary safety equipment such as protective eyewear and fire extinguishers should also be available.

In science teaching, scientific tools and equipment are used to facilitate learning by helping students refine their understanding of science concepts and build new knowledge. These resources are necessary to conduct inquiry in the science classroom. Specific tools include measurement instruments (scales, balances, thermometers, beakers, pipettes) data collecting devices (calculators, meters), probes (temperature, speed, pressure), simulations (dissections, virtual labs) visualization tools (binoculars, microscopes, telescopes, spectrosopes, models) and computer technologies such as satellite, world-wide networks, webcams and videoconferencing expand the reach of the classroom to different audiences.

The benefits for using these materials in a science classroom include increased accuracy and speed in data collection, analysis, interpretation and display of large volumes of data, real-time visualization and close observation, interactive modeling of science processes and structures that are not visible, teacher demonstrations and presentation and communication of results. Additionally, instructional technologies are very important in the science classroom for engaging and motivating students of all abilities and backgrounds in the learning process. For example, visualization tools and simulation software makes it possible for students to “see” and “manipulate” objects and phenomena that would be difficult or dangerous hands-on experiences. It is not the tools and equipment in the classroom, but how these resources are used that makes the difference in student learning. These resources should be used to support student understanding and reflection in science.

The CMSP Science Curriculum Guides includes a section that lists the specific tools used in the corresponding discipline of science along with a description of the tool and the content knowledge and/or skills developed by using the tool. For example, using a simulation in earth and space science, students can simulate the conditions on the earth given a particular variable. Using a telescope or binoculars, students can observe objects in the solar system at closer distances. Additionally, the guide highlights how people use tools and materials to modify or create new technologies as part of the Engineering and Technology Connections section.

**Rigorous and Meaningful Instruction**

**Core Content (Tier I)**
The instructional design we will implement for the CMSP is called *LESA with the 7Es*. Launch, Explore, Summarize and Apply (LESA) is a common learning cycle that has
been implemented as part of mathematics instruction in MPS for several years. The 7E design, commonly applied in science instruction, is used here to articulate the specific practices within each of the four phases LESA.

LESA with the 7Es is a re-thinking of both designs to develop an instructional approach for the CMSP that supports teaching and learning in both mathematics and science, maintains the integrity of both disciplines and honors the work and progress that has occurred in both subject areas in MPS and the professions overall.

It is critically important that students have opportunities to experience each phase of the instructional design during a lesson to optimize their learning for a particular science concept. Depending on the lesson, the times for each phase of the learning cycle will vary.

- Launch

Elicit: In light of current research in cognitive science, the 7E instructional model adds Elicit before Engage. Research supports that eliciting prior knowledge and understanding is an essential cornerstone for learning (Bransford, Brown and Cocking, 2000). It informs teacher instruction and readies the learner for new information.

Engage: The engage component is intended to peak the students’ interest and stimulate their thinking. It may be accomplished through a discrepant event, demonstration, or simply through inquiry-based questioning. The Elicit and Engage phases generally occur during whole group instruction, but may also involve individual or small group experiences that elicit prior knowledge and engage students’ interest in the science content.

A physics lesson on seat belts (Eisenkraft, 2003) provides a typical example of how the 7E model may be utilized in the classroom. Students may be given a challenge to design a seatbelt for a racecar traveling at high speeds. To elicit prior understanding, the teacher may ask how racecar seatbelts differ from those available on passenger cars. Students may write their thoughts in a science notebook and then share them with a partner or the whole group. The teacher may then engage the students by discussing car accidents they have seen in movies or real life.

- Explore

The explore stage in science is where students experiment. This experimentation can occur individually, but tends to be more effective in small groups. Students develop hypotheses, make observations, record data, isolate variables, design and plan the experiment, create graphs, interpret results and organize and communicate their findings.
In the seatbelt lesson, students would explore the challenge further by constructing a figure made out of clay that can sit in a small cart. Students then crash the cart into the wall, observing the action of the clay figure.

- **Summarize**

*Explain:* In the explain phase of the instructional model, students summarize results in terms of newly learned theories and models. The teacher assists students with incorporating science vocabulary as they explain what they have learned.

To explain what happens to the clay figure when the cart in the seatbelt lesson crashes into the wall, the teacher would explain that students' observed Newton's first law of motion. She could then re-engage the students in the learning challenge by showing simulated automobile crashes utilizing crash test dummies. Students would then be asked how they could save their clay figure from injury during its crash into the wall, eliciting a seatbelt as a plausible solution.

Students would then explore this solution by creating seat belts made from thin wire, then repeating their crash test and observing that the wire slices midway through the clay figure during the crash. The concepts of pressure, force, and area are then introduced to the students to explain their observations and the students recognize that a wider seat belt is needed.

*Elaborate:* As students elaborate, they apply their knowledge to new contexts within the current situation. Teachers can have students apply the newly learned concepts to new contexts, e.g. pose a different (but similar) question and have students explore it using the concept. It is during the elaborate phase that “transfer of learning” occurs (Thorndike, 1923).

To elaborate on this observation, students create wider seat belts and explain their value in terms of Newton’s first law and forces.

- **Apply**

*Evaluate:* The evaluate phase of the model includes both formative and summative assessments of student learning. Formative assessment should be occurring at all of the phases of the instructional design, e.g., during all interactions with students—again reinforcing that the design is not a linear progression, but a cyclical one.

To evaluate what the students have learned during the physics lesson, the teacher would now ask them to design a seat belt for a race car that travels at 250km/h. The students’ create designs and compare them to actual seat belts used by NASCAR. The extension of student learning could then be applied by challenging them to explore how automobile airbags work...
and the mechanisms behind why they inflate when a car hits a tree and not during a minor fender-bender.

*Extend*: The extend phase emphasizes the transfer of learning also, but involves applying newly acquired skills and knowledge to *new* situations within the domain. Teachers lead students to connect the concept to different contexts.

The cyclical nature of instruction during the sample physics lesson shows how the phases of the 7E model may be repeated as necessary in a non-linear progression to create a complete learning experience for students.

**Instructional Time**
As suggested earlier, instructional time is limited, but is a very valuable resource that, when managed well, is an important part of effective instruction. While it is increasingly difficult to ensure recommended instructional minutes in science education amidst larger resource and policy constraints, including Corrective Action Requirements, DPI insists and MPS expects science instruction to be *regularly delivered*. Regular is defined as daily or every other day throughout the school year. A school may not offer science quarterly or only for one semester. Science instruction should include both content learning and hands-on/inquiry learning and laboratory studies.

**Instructional Design Classroom Implementation Guide**

**Purpose**: High-performing districts and schools adopt high, common expectations for what children should know and be able to do, develop a shared vision of effective instruction, align resources (e.g., curriculum, assessments, professional development) and systems (e.g., support and accountability) and build professional learning communities (e.g., peer observations, coaching supports, student-focused conversations, feedback) around these. Consistent with this approach, the following “reminders” or “look-fors” are provided for classroom teachers, coaches and school leaders to support implementation of the Comprehensive Mathematics and Science Plan (CMSP) with fidelity and support continuous improvement in science teaching and learning for *every* student. Educators are encouraged to use this tool to guide informal observations and discussions of classroom implementation of the CMSP and four domains of effective teaching—planning and preparation, classroom environment, instruction and professional responsibilities.

The Classroom Implementation Guide is not meant to serve as an evaluation tool or a checklist. It recognizes that teaching is a complex task that requires teachers who are skilled at matching learning objectives, student learning needs, instructional/curricular resources and best practices to ensure that all children achieve to high standards. As such, the look of classrooms effectively implementing the CMSP will be diverse. Likewise, the type and intensity of support teachers and school communities need will differ.
**LAUNCH**

<table>
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<th>Purpose:</th>
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<tbody>
<tr>
<td>To capture the learner's attention</td>
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<tr>
<td>To activate and access prior understandings</td>
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This practice places emphasis on students’ prior experiences. The teacher accesses student’ prior understandings by eliciting tacit knowledge that can be used as a foundation for the learning to come. It is imperative to address this phase, because failure to do so may lead students to construct understandings very different from the ones intended by the teacher.

**Questions to consider when planning this phase:**
- What prior knowledge do my students have?
- How will I build on their prior understandings?
- What difficulties can I foresee?

**What kinds of questions can I ask:**
- Is there anything you don’t understand about ______?  
- What do you wonder about regarding ________?

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**ENGAGE**

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<th>Purpose:</th>
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<tr>
<td>To continue from the elicit phase to excite and interest students in whatever ways possible and to identify prior conceptions.</td>
</tr>
<tr>
<td>To capture students’ attention, get students thinking about concept, skill, or issue, raise questions in students’ minds and stimulate thinking.</td>
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This practice includes both accessing prior knowledge and promoting curiosity and enthusiasm for the content matter. The teacher helps students become actively engaged in a new concept through the use of short activities. The activity should make connections between past and present learning experiences, expose preconceptions and organize students’ thinking toward the learning intentions of the activity. Here is where the teacher can motivate, capture student interest and get them ready to learn by using a discrepant event, telling a story, giving a demonstration, showing a visual (object, model, picture, short video or simulation) and having a corresponding conversation/discussion.

**Questions to consider when planning this phase:**
- How will I organize the students to explore? (Individuals? Groups? Pairs?)
- What materials will students need to encourage diverse thinking and problem solving?
- How can I connect the engagement activity to students' previous knowledge?

**What kinds of questions can I ask:**
- What do you think?
- Why is it that…?
- How might you?

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**EXPLORE**

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<tr>
<td>To lock in the learning</td>
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<tr>
<td>To articulate scientific ideas and vocabulary from the lesson</td>
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Exploration experiences provide students with common learning experiences within which current concepts, preconceptions, processes and skills are identified and conceptual change is facilitated. The teachers role is to provide support and scaffolding by helping students use their prior knowledge to generate new ideas and explore questions. The teacher serves as the facilitator of learning by asking questions, suggesting approaches, providing feedback and assessing understandings. Students have opportunities to observe, make predictions, develop hypotheses, design and conduct preliminary investigations, collect and record data, create charts and graphs, interpret results, draw conclusions and raise new questions. The students’ role is to construct their own understanding.
through active and concrete experiences.

**Questions to consider when planning this phase:**
- What different strategies might I anticipate students using to explore?
- How can I orchestrate the discussion so the students express their thinking?
- What science, including strategies needs to be emphasized?

**What kinds of questions can I ask:**
- What are your guesses about what will happen?
- What does your data tell you?
- What do you need to find out?
- Would it help to compare your ideas to someone else’s?

<table>
<thead>
<tr>
<th>SUMMARIZE</th>
<th>Explain</th>
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</table>
| **Purpose:**
- To articulate scientific vocabulary to explain the results of their explorations |

This practice focuses students’ attention on a particular aspect of their engagement and exploration experiences and provides opportunities for them to demonstrate their conceptual understanding, skills, behaviors, or dispositions. The teacher directly introduces a concept, process, skill, or issue and helps students with related scientific vocabulary. The teacher explanations or curricular materials (instructional media, texts) guide the students toward a deeper understanding. Students have opportunities to verbalize and clarify the content of the exploration using scientific language. The students’ role is to explain their understanding about what is being addressed in the lesson. Students can report findings, discoveries and summaries of their explorations in small or large groups.

**Questions to consider when planning this phase:**
- What questions can I provide to help students use scientific vocabulary to explain the results of their explorations?
- What science, including strategies, needs to be emphasized to help student demonstrate their conceptual learning?
- What questions can I ask to focus students if they become frustrated or off task?
- What questions can I ask to encourage student conversation and thinking?

**What kinds of questions can I ask:**
- What previous concept/understanding connects to this exploration/lab/activity?
- What have you learned or discovered today?
- Does your data seem reasonable? Does the data confirm your hypothesis?
- If your results are different from your hypothesis explain why you think that is the case.

<table>
<thead>
<tr>
<th>SUMMARIZE</th>
<th>Elaborate</th>
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</table>
| **Purpose:**
- To articulate scientific vocabulary to explain the results of their explorations |

In the elaboration phase teachers challenge students’ conceptual understanding and skills. Through new experiences, the students develop deeper and broader understanding, more information and adequate skills. Students apply their understanding of the concept by conducting additional activities. The practice allows for students to transfer their learning from one concept to another, one subject to another, one year to another, or school to non-school activities. Elaboration is difficult for most students and requires many chances for students to practice. When students are able to transfer their learning, we know that learning really happened. Teachers have students apply the new learning to new contexts. A teacher
may pose a different (but similar) question or hypothesis and have students explore it using the same science concept or the teacher may ask students to change a variable in a science investigation using the same science concept.

**Questions to consider when planning this phase:**
- What questions can I provide to help students use scientific vocabulary to explain the results of their explorations?
- What science, including strategies, needs to be emphasized to help student demonstrate their conceptual learning.

**What kinds of questions can I ask:**
- Can you create a diagram to show the relationship of the concepts?
- What previous concept understanding connects to this question?
- How does what we learned today compare or contrast with what we learned previously…?

### APPLY

#### Evaluate

**Purpose:**
- To lock in the learning
- To articulate mathematical ideas and vocabulary from the lesson
- To have students compare and contrast ideas and strategies

This practice encourages students to assess their understanding and abilities and provides opportunities for teachers to evaluate student progress toward meeting the objectives of the lesson. Teachers use formative assessments to gather feedback on student progress toward understanding key concepts and use summative assessment to provide a grade. Formative assessment of student learning should occur during each phase of the instructional cycle. When eliciting student’s background knowledge teachers are checking for student understanding. Teachers should draw on multiple classroom assessment approaches during the Explore and Explain phases to continue to check for student understanding.

**Questions to consider when planning this phase:**
- What will I do to follow up, practice or apply the learning?
- What ideas do not need closure at this time?

**What kinds of questions can I ask:**
- What big idea(s) did we learn today…?
- Can you create a diagram to show the relationship of the concepts?
- Can you summarize what you learned today?
- Can you describe your procedure/results to the rest of the class? Can you explain why you got the results that you observed?

### APPLY

#### Extend

**Purpose:**
- To practice what students learned
- To extend the use of skills and concepts learning
- To make connections to other learning

The extend phase is an addition to the elaboration phase of the instructional/lesson/design as an explicit reminder for teachers of the importance to provide students many opportunities to practice transfer of learning. This aspect of the design allows for the extending, or transfer, of concepts. This practice leads students to connect or apply the concept to different, new contexts.

**Questions to consider when planning this phase:**
- What questions or problems are appropriate for my students to do after the investigation?

**What kinds of questions can I ask:**
- Where might you use…?
- How does this relate to…?
- What would happen if…?
- What previous concept understanding connects to this question?
Standards-based Assessment

Student learning and performance improves when assessment is a regular part of classroom practice. Assessment research and professional science organizations such as the National Research Council contend that good assessment practice uses both formal and informal assessment of student progress. Assessment should measure current achievement level of students and, as important if not more, should also monitor and report on student growth over time (NSES, 2001). Assessment based on national, state and/or local standards is an effective vehicle for feedback to students and teachers as well as parents, the school district and the community and the feedback to students should be aimed at improving their performance.

Multiple assessment methods should be used to not only gauge what students have learned and what they can do, but to also determine what they are thinking and how they are reasoning for the teacher to know what instructional steps to take next. For example, science students should have opportunities to express their science ideas both orally and in writing. When a student is asked for a written explanation, it often helps the student clarify his or her thinking and can help show the student’s capacity to apply information. Multiple assessment data also allows teachers to refine their knowledge regarding the content, make modifications to pedagogical techniques, plan and align curriculum and adjust the cognitive level of content.

Assessments have different purposes and each assessment strategy has its own strengths and weaknesses, which is why using evidence from a wide variety of classroom assessment is important for giving a more accurate, comprehensive and ongoing picture of student learning and academic progress (Stiggins, 2006).

Formative Assessments

Teachers should use formative assessments to determine what their students know already and what they need to know. They should use the results of these assessments to plan relevant lessons and guide daily instruction. They should communicate expectations with students prior to the task/assignment and provide regular descriptive feedback to improve performance and monitor student progress.

Students should use formative assessments to become aware of their own progress and areas of strength and improvement. They should have access to exemplars of student strong and weak work, rubrics and scoring guides and opportunities to revise their work. These aspects of assessment promote quality performance and help students to gain a deeper understanding of the content or skill (Tweed, 2009).

Constructed-response questions and performances are two common types of formative assessment. Constructed response or extended written response assessment requires students to give, rather than select, an appropriate response. Students demonstrate their learning by choosing how to answer the question. Constructed response questions also support more than one strategy where a clear written explanation could also include tables, graphs and equations. Performance assessments integrate concepts, skills, facts, reasoning and inquiry and demonstrate how students apply their knowledge and
skills. Assessments such as student portfolios, student conferences and interviews, teacher observations and science notebooks allow students to demonstrate their learning and progress.

Types of formative assessments and formative assessment strategies include:

- MPS Classroom Assessments Based on Standards (CABS)
- MPS MAP Assessments
- Inquiry labs, Mini-labs, Quick Labs
- Short and Long-Term Projects
- Performance Assessments/Tasks
- Research
- Field activities
- Demonstrations
- Virtual investigations
- Written explanations
- Presentations/Oral responses
- Models, Drawings and Pictures
- Diagrams, Graphs, Flowcharts, Concept Maps
- Anecdotal notes
- Classroom discussions
- Teacher observations
- Interviews
- Science Notebooks and Journals
- Student Portfolios

**Summative Assessments**

Summative assessments can occur inside and outside the classroom. Inside the classroom they measure the student’s understanding of the significant scientific content and often measure the student’s ability to illustrate their understanding and/or apply their understanding to a problem or new context. The results are used to evaluate the overall effectiveness of lesson planning and revise the instruction for the next group of students, as well as possibly point out the need for different instructional materials or a curriculum revision.

Outside the classroom, summative assessments are typically a state examination (sometimes a district “benchmark” test) used to evaluate student learning at the end of a grade, number of years, or a course. These results can be analyzed to pinpoint weaknesses and hypothesize and test possible causes and remedies to the science program as a whole.

Common summative assessments include selected response methods (true-false, multiple-choice, matching, short answer and fill-in questions), which generally assess knowledge and factual information.

Types of summative assessments and summative assessment strategies include:
• Wisconsin Knowledge and Concepts Examination (WKCE)
• Textbook Assessments
  • Section tests
  • Chapter tests/reviews
  • Quizzes
  • Standardized test practice/preparation

Standards-based Report Card
In science, teachers will assess students’ proficiency levels on the six areas of the Next Generation Science Framework.

<table>
<thead>
<tr>
<th>Life Sciences</th>
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<tbody>
<tr>
<td>Earth &amp; Space Sciences</td>
</tr>
<tr>
<td>Physical Sciences</td>
</tr>
<tr>
<td>Engineering &amp; Technology</td>
</tr>
<tr>
<td>Topics in Science, Engineering, Technology and Society</td>
</tr>
<tr>
<td>How Scientists and Engineers Work (Practices)</td>
</tr>
</tbody>
</table>

**ENGINEERING CURRICULUM, INSTRUCTION AND ASSESSMENT**
Engineering is the discipline of the designed world. “The designed world consists of all the modifications that humans have made to the natural world to satisfy their own needs and wants. As its name implies, the designed world is the product of a design process that provides ways to turn resources – materials, tools and machines, people, information, energy, capital and time – into products and systems” (ITEEA. 2007, p.140).

The different fields of mathematics, science and engineering all have domains of knowledge, process skills and ways of looking at the world. For engineering the key approach to problem solving is design. The design process integrates various skills and types of thinking-- “analytical and synthetic thinking; detailed understanding and holistic understanding; planning and building; and implicit, procedural knowledge and explicit, declarative knowledge” (NAE, 2009, p.37).

Engineering design is the approach engineers take to make an artifact or process, which serves a specific purpose. The design process is iterative. Each step is tested and changed based on learning up until that point. But, at any point in the design process, there is not one absolute solution to the challenge at hand. The design process reveals multiple solutions from which to pick depending on constraints (ITEA, 2007, pp. 91–92).
Engineering is connected to, has similarities with and can effectively work to support mathematics and science education. There are many similarities in the engineering design process and the inquiry methodology of science. To understand how the two areas can complement each other in K-12, it is important to see the similarities and differences.

Both fields use similar reasoning processes, “Navigational devices that serve the purpose of bridging the gap between problem and solution” (Lewis, 2006, p. 271). Both scientists and engineers use similar tools like brainstorming, analogy and modeling. Both use testing and assessment, whether of an engineering design or a scientific hypothesis. The divergence comes in several areas. Notably, constraints affect each discipline differently. A budget constraint may limit scientific inquiry, but not change the result of the inquiry. Budget constraints will change the direction of an engineering design to find a solution within budget. Another difference is in trade-offs, used extensively in the design process but having no role in the scientific method. Several other differences stand out.

The National Research Council (NRC) and The National Academy of Engineering, September 2009, reported on the findings of an expert committee that was charged with evaluating the status of engineering lessons in PreK-12 schools and judging their effectiveness. They concluded that engineering studies, or lessons on how products are designed and built, have the potential to bolster student engagement and understanding in mathematics and science and called for engineering to be integrated into PreK-12 curriculum. Engineering in K-12 Education (National Academies Press, 2009) states that engineering education in PreK-12 classrooms is a small but growing phenomenon that may have implications for engineering, as well as for the other mathematics, science and technology subjects and courses. Specifically, engineering education may improve student learning and achievement in science and mathematics, increase awareness of engineering and the work of engineers, increase student interest in pursuing engineering and increase the technological literacy of all students.

To support the goals of the CMSP, MPS will continue to expand and improve its technology and engineering related programs and courses, including robotics, information technology and Project Lead The Way engineering programs. Each of these will be aligned to research-based practices and National Academy of Engineering (NAE) principles (as described above), as well as the Common Core State Standards for Mathematics, the Next Generation Science Framework, International Technology and Engineering Educators Association (ITEEA) Standards for Technological Literacy and the CMSP instructional/lesson design. Aligned enrichment and experiential learning opportunities, both during and beyond the school day are also becoming increasingly available to provide students with concrete, real-world applications and integration of engineering and technology to improve student learning and achievement in mathematics and science.
Standards and Research-based Curriculum

Standards
The National Academy of Engineering (NAE) articulates the relationship of science to engineering processes, as captured below (AAAS, 1989; ITEA, 2007).

<table>
<thead>
<tr>
<th>Scientific Inquiry (Investigate):</th>
<th>Engineering Design (Create):</th>
</tr>
</thead>
<tbody>
<tr>
<td>Demands evidence</td>
<td>Is purposeful</td>
</tr>
<tr>
<td>Is a blend of logic and imagination</td>
<td>Is based on certain requirements</td>
</tr>
<tr>
<td>Explains and predicts</td>
<td>Is systematic</td>
</tr>
<tr>
<td>Tries to identify and avoid bias</td>
<td>Is iterative</td>
</tr>
<tr>
<td>Is not authoritarian</td>
<td>Allows many possible solutions</td>
</tr>
</tbody>
</table>

The NAE further notes, “The distinguishing features of engineering design include taking into account specifications and constraints; dependence on iteration; and the embrace of multiple possible solutions. The differences in the two lists reflect the basic differences between science and engineering—scientists investigate and engineers create.” (NAE, 2009: 41).

Much of K-12, as well as post-secondary, engineering education is spent on developing students’ understanding and capabilities in the iterative, open-ended, problem-solving method of engineering design. In practice, many educators in this field have seen that design activities provide a real-world focus for abstract concepts, which may have a positive impact on learning not only in engineering, but also in the related subjects, such as mathematics and science.

In addition, the Standards for Technological Literacy (STL) provide a framework for what students should know and be able to do in order for them to be technologically literate. In sum, engineers are professionals who use the scientific and mathematical “tools” at their disposal. The following ITEEA Standards lay the foundation for engineering education in MPS:

**Engineering Design and Design Attributes**
- Create planning processes that lead to useful products and systems
- Design requirements including criteria
- Apply a design process to solve problems
- Specify criteria and constraints for design
- Design is influenced by personal characteristics
- Visualize and think abstractly
- Understand how the design will be developed, produced and maintained
• Evaluate proposed or existing designs in the real world

Problem Solving in Engineering
• Use troubleshooting as a problem solving method to identify the cause of malfunction in a technological system
• Turn ideas and imagination into devices and systems
• Modify existing products or systems to improve them
• Use multidisciplinary approaches to solve technological problems
• Assess previously ignored solutions
• Evaluate final solutions to ensure that products are of high quality

Abilities for a Technological World
• Make two-dimensional and three-dimensional representations of designed solutions
• Develop plans and directions for how artifacts are to be constructed
• Test and evaluate designs based on criteria
• Understand the effects of technology on the environment
• Understand that decisions to develop and use technologies often put environmental and economic concerns in direct competition with one another
• Use power systems to drive and provide propulsion to other technological products and systems

Automation and Robotics
• Trace the history, development and influence of automation and robotics
• Learn mechanical systems, energy transfer, machine automation and computer control systems
• Operate systems so that they function in the way they were designed

Curriculum
Project-based learning (PBL) curriculum is driven by important questions that tie content standards and higher-order thinking to real-world contexts. Often, students collaborate with outside experts and community members to answer questions and gain deeper meaning of the content. Projects are used as formative assessments providing students multiple opportunities to apply what they have learned and to produce high-quality work. In MPS, the nationally recognized PBL curriculum, Project Lead the Way (PLTW), is used to teach and apply engineering principles in both core and elective courses in middle and high school levels.

The middle school curriculum, Gateway to Technology, is a series of lessons taught by specially trained teachers that are intended to enhance existing science and mathematics courses.

In high schools, PLTW supports a series of courses that are aligned with state and national content standards in science and math. These courses include:
  ▪ Introduction to Engineering and Design (IED),
- Principles of Engineering (POE),
- Digital Electronics (DE),
- Civil Engineering and Architecture (CEA),
- Biotechnical Engineering (BE) and
- Computer Integrated Manufacturing (CIM).

These courses require an understanding of the scientific process and mathematical competence to design and build structures, machines, devices and systems. High school teachers with science, math and career and technical education backgrounds receive intensive summer instruction from engineering professors to become certified instructors.

Data from MPS’ current implementation of PLTW highlight the potential for positively enhancing math and science education through the engineering coursework. In early data, MPS students in PLTW have shown positive gains in WKCE test scores, as well as increased attendance rates, increased persistent rates to graduation and increased participation of nontraditional populations.

Engineering is Elementary (EiE) is currently implemented in several MPS elementary schools with the purpose of exposing students to engineering concepts and related careers. EiE aligns well with PLTW, mathematics and science and in creating a positive learning experience for students that will encourage them to pursue college and careers in engineering or related fields.

MPS also implements courses applying engineering principals and using national ITEEA standards that focus on robotics in high school and afterschool and summer activities that promote engineering education through robotics, advanced manufacturing and computer systems. The MPS classroom robotics program was developed by Robotics Institute at Carnegie Mellon University (Carnegie Mellon, the Robotics Institute, 2011).

Rigorous and Meaningful Instruction
According to the National Academy of Engineering, engineering education should aspire to follow three principles:

- K–12 engineering education should emphasize engineering design. Engineering approaches problem solving using the design process which is iterative, offers multiple solutions; provides context for academic learning and encourages systems thinking, modeling and analysis.

- K–12 engineering education should incorporate important and developmentally appropriate mathematics, science and technology knowledge and skills. Mathematics concepts and computation and scientific concepts and inquiry are both used to support engineering education. Technology provides the tools to produce outcomes from the design process.

- K–12 engineering education should promote engineering habits of mind.
• Systems thinking - Systems thinking asks the student to recognize the interconnectedness in the human-made world and the intended and unintended consequences of engineering design.
• Creativity – the design process is a creative process
• Optimism - required by the view that any challenge can be engineered
• Collaboration - engineering is a team sport.
• Communication – essential for collaboration
• Attention to ethical considerations – increasingly important in the engineering field. (NAE, 2009: 151-153.)

Instructional Design
Engineering and engineering related instruction emphasizes project-based learning. As summarized earlier, PBL is a student-centered instructional approach in which project work is central to student understanding of the essential concepts, principles and skills of a discipline. It brings together intellectual inquiry, rigorous real world standards and student engagement in a relevant, real world and authentic context. When fully implemented, PBL allows the student to take the lead, asking and answering questions and making critical choices and decisions. This form of learning draws on multiple disciplines to solve problems and deepen understanding. Most often PBL results in authentic demonstrations of useful or functional products and performances.

Standards-based Assessment
Each of the engineering curricula offers comprehensive assessments. PLTW high school courses are nationally assessed using a system of portfolio, Rubrics and written testing developed through the Northwest Evaluation Association (NWEA), which coordinates data with the MPS MAP testing system. The Carnegie Melon curriculum provides formative, project-based assessments. These assessment tools provide opportunity to accommodate students with special needs and English Language Learners.

Making the Connections – Mathematics, Science and Engineering
Mathematics, science and engineering are interdependent disciplines that represent distinct ways of looking at the world. Mathematics expresses patterns and relationships in the natural and designed worlds. It is used for constructing theories and models. It enables the numerical representation of variables and their relationships, the symbolic representation of physical entities, the development of explicit theoretical accounts of the physical world and the prediction of possible outcomes. Science is a way of answering questions and providing explanations about the events that happen in the natural world. The National Research Council and others stress the importance of developing student familiarity with the role and use of mathematics in science to advance their understanding of how science works and deepen their mathematical learning. Engineering, as discussed above, is the discipline of the designed world and creates artifacts or processes taking into account specifications and constraints; it is dependent on iteration and embraces more than one solution.
Learning in mathematics and science in interconnected ways increasingly enables students to be thinkers, problem solvers and innovators in any classroom and career field. Engineering education both enhances learning in mathematics and science and uses concepts and process from these two other disciplines. Certain science concepts, as well as the use of scientific inquiry methods, can support engineering design activities. Similarly, certain mathematical concepts and computational methods can support engineering design, especially in service of analysis and modeling. Mathematicians and scientists use the products of engineering in their work. “Thus the relationship between engineering and science and mathematics is a two way street.” (NAE, 2009, p.44>
SECTION III: TEACHER RESOURCES
Curriculum guides, pacing guides and lesson plan templates are provided electronically as separate documents.

MATHEMATICS CURRICULUM, PACING AND LESSON PLANNING GUIDES
As described earlier, high quality curricula and instructional materials are essential to ensuring effective instruction aligned to rigorous Common Core State Standards. District-developed curriculum and pacing guides, therefore, serve a valuable role in clearly articulating targeted content, scope, sequence and pacing across grade levels and courses. These resources support common, consistent implementation of the CMSP in mathematics classrooms district wide. These pacing guides and common course plans can be found on the MPS Portal.

SCIENCE CURRICULUM, PACING AND LESSON PLANNING GUIDES
As described earlier, high quality curricula and instructional materials are essential to ensuring effective instruction aligned to rigorous standards. District-developed curriculum and pacing guides, therefore, serve a valuable role in clearly articulating targeted content, scope, sequence and pacing across grade levels and courses. These resources support common, consistent implementation of the CMSP in science classrooms district wide. These pacing guides and common course plans can be found on the MPS Portal. Curriculum guides have been developed for grades K-12 in grade bands K-2, 3-5, 6-8 and 9-12 for the life sciences, Earth and space sciences and the physical sciences. Pacing guides aligned to the Core Ideas of the Next Generation Science Framework and district adopted materials are also included for kindergarten through grade eight and for Physical Science, Biology, Chemistry, Physics and Environmental Science. Sample Lesson Plans using the CMSP Instructional Design are also included.
Effective implementation of the CMSP requires a variety of implementation supports and continuous improvement efforts, from ongoing progress monitoring, including regular checks on implementation fidelity, to organizational development, including building leadership capacity, staff development and parent and community engagement and support.

**Fidelity of Implementation**
Fidelity of Implementation is the delivery of an intervention, program or curriculum in the way in which it was designed to be delivered. Schools not meeting the required level of fidelity of implementation of core instruction of the CLP and CMSP, PBIS, tiered interventions and progress monitoring will receive a Plan of Rapid Compliance to ensure the school moves towards making corrections in their level of fidelity.

**Fidelity of Implementation of the Core Instruction**
Refer to RtI Handbook – FOI of Tier I p. 50, FOI of Tier 2 p. 76, FOI of Tier 3 p. 92 –

**Leadership Capacity**
As the Council of Great City Schools reported,

“...One of the most substantial challenges facing the district involves the strategic issue of decentralization versus more standardization. The district made the decision long ago to decentralize, but in the process of decentralizing, it did not define which decisions were best left to the district and which were appropriately delegated to the schools. Instead, each school was given so much latitude in decision-making that MPS has become a system of schools rather than a school system”.

“Decentralization has rendered the central office instructional unit irrelevant to the process of raising student achievement. The central office has largely abdicated its leadership role for the instructional program and student achievement”

MPS has created increased managerial demands on principals. Professional development and accountability emphasized compliance and fiscal management and diminished focus on systemic change and student performance. CMSP implementation demands both.

**Background**
As MPS takes on this important work of implementing the CMSP focused on these features, it is developing new partnerships to help improve district infrastructure, systems and skills for improvement. This includes work to better develop district and school
leaders, as well as reorganize regional systems of school support, as described earlier. Undergirding this work are several key principles. In particular, the recognition that in school improvement, leadership:

- exists at multiple levels (e.g., district, region, school, department/grade, classroom);
- involves multiple actors (e.g., school board members, district superintendent and senior leadership, regional leaders, central office staff, principals and assistant principals);
- teacher leaders—coaches and department chairs);
- takes many forms (e.g., symbolic, political) and is approached through different; paradigms (e.g., distributive leadership, transactional or transformational); and
- affects different conditions (e.g., instruction, supervision/management).

**District Leadership**

MPS has moved towards a performance-based culture which is reflected in the strategic organization and planning processes of the central office and its teams. These were intentionally redesigned to add value to the regional organization. In particular Career and Technology Education, Mathematics and Science offices are collaborating, developing teacher and staff resources and designing professional development to support the Comprehensive Mathematics and Science Plan. These collaborative efforts extend to include other content areas (i.e. literacy, social studies, music, art and physical education) and departments (i.e. early childhood, pupil services/parent involvement, specialized services, bilingual education) as well to ensure systematic integration.

As part of district leadership support to schools, mathematics and science teaching specialists will work collaboratively to provide focused service to targeted teachers. Using a case management approach the specialists will be strategically assigned to teachers in each of the five regions to support efforts to improve mathematics and science achievement. Time is allocated strategically for the teaching specialists to work with school staff and district regional specialist to implement the design of the CMSP and monitor its implementation. Teaching specialists provide critical school-based and district wide targeted professional development, participate in school leadership teams and support development of school improvement plans. They work directly with classroom teachers by demonstrating and modeling effective teaching strategies and formative assessment principles for informing instruction and improving student learning. Specialists support teacher observation by working with principals and school leaders to provide targeted, descriptive, effective feedback.

Staff from Mathematics and Science Education Services collaborate with Special Education, Bilingual Education and Research and Evaluation to design content specific professional development aimed at supporting schools to more effectively serve students receiving special education services and English Language Learners (ELL). This collaborative effort increases schools’ ability to differentiate across content areas and make better use of data to determine the needs of the school.
Regional administrators are aligned to each of the five regions for the purposes of support for principals and school leaders and to hold school leaders and themselves accountable for improved outcomes for students. This model is one that clearly aligns support and accountability for results in three important areas: curriculum and instruction, school operations and special education services. The positions are as follows:

- The Regional Director of School Support assumes general oversight of day-to-day activities of the principals and helps ensure compliance with district administrative requirements and deadlines.

- The Regional Coordinator of Specialized Services helps to ensure compliance with various special education regulations and to improve educational outcomes for students with special education needs.

It is the responsibility of the Regional Executive Specialist to ensure that schools receive targeted interventions and supports as needed. This structure creates a stronger accountability interface between the overall district and the schools. It resolves the issue of competing interests by establishing teams distinctly accountable for improved school performance. The model encourages a means for both vertical and horizontal articulation of the work of the district and outcomes at the school level.

School Leadership

Across organizational levels and perspectives, leadership is critical to affecting systemic, not just school-specific, change. District level leadership is charged primarily with setting the vision and conditions for school success. The principal is primarily responsible for creating conditions at their schools and opportunities for their staff that foster effective teaching and learning. The evidence shows school leadership is second only to teaching in its effects on student learning. About one-fourth of the variation in student achievement can be explained by school leadership (Leithwood, Louis Anderson and Wahlstrom, 2004; Branch, Hanushek and Rivkin, 2009; Hallinger and Heck, 1998).

Additional studies identify the principal as critical to the success of those designs (Berends, Bodilly, & Kirby, 2002; Murphy & Datnow, 2003; Supovitz & Poglinco, 2001). The influence of principals is particularly strong in turning around low-performing schools. As one study noted,

“…there are virtually no documented instances of troubled schools being turned around without intervention by a powerful leader. Many other factors may contribute to such turnarounds, but leadership is the catalyst” (Leithwood, Louis anderson and Wahlstrom, 2004: 5).

However, effective principals in such schools play other roles as well. As a research compendium prepared for the U.S. Department of Education found, “school leadership is a key part of school change and turnaround” (Herman et al., 2008, p. 10). In such schools, the study found that effective principals signal the need for dramatic change,
maintain a consistent focus on improving instruction, provide visible improvements—quick wins—early in the turnaround process and build a committed staff (Leithwood, Steinbach & Jantzi, 2002).

Principals affect student learning by setting school goals and providing a direction for the faculty and staff (Dwyer, 1986; Newmann, 1997; Bryk & Schneider, 2002). Leithwood and Jantzi (2005) found that principals, by building a school vision, setting goals and priorities and holding high performance expectations, motivated teachers and developed their capacity to teach more effectively. These changes reformed classroom practice; goal-setting activities raise teachers’ expectations for students’ performance. In addition to setting goals and expectations, effective principals also monitor performance and promote communication and collaboration to help ensure that the goals are being met and if not, where to direct resources to improve (Leithwood, Louis Anderson and Wahlstrom, 2004).

Other research has found that a core job of effective principals is to diagnose school needs and design strategies to address those needs (Portin, DeArmond, Gundlach and Schneider, 2003; Spillane, 2009; Knapp, Portin, Copland and Pleck, 2006; Leithwood, Louis Anderson and Wahlstrom, 2004; Ladd, 2009). Rather than come in with a detailed road map for improvement, principals examine a school’s current state, assess its most pressing problems and develop, along with the school’s leadership team, a plan for meeting the challenges.

Research also suggests that one of the most important functions of leadership is the recruitment and development of human capital in their schools. That is, principals attract, develop and retain strong teachers (Odden and Archibald, 2001; Beck and Murphy, 1996; Harris, Rutledge, Ingle, & Thompson, 2006). As Christopher Cerf, the deputy chancellor of the New York City Department of Education put it: “Pick the right school leader and great teachers will come and stay. Pick the wrong one and, over time, good teachers leave, mediocre ones stay and the school gradually (or not so gradually) declines.” Given the high demand for and limited supply of qualified mathematics and science teachers across the country and particularly in high-poverty districts, this role and that of supporting mathematics and science teachers is especially important to the success of the CMSP.

**Teacher Leadership**

Studies have pointed to the role of coaching, teacher supervision and other practices that foster instructional improvement in schools as critical to improving student achievement (Leithwood and Duke, 1999). Studies also show that instructional leadership is too big a job for a single individual and that the principal’s job is to identify potential teacher leaders, nurture and develop them and guide their work (Portin et al., 2003). Effective principals are leaders of instructional leadership teams; more orchestra conductors than soloists (Spillane, 2009; Portin et al., 2009; Bryk and Schneider, 2002; Gronn, 2002). Such an approach helps school improvement by enabling principals to take advantage of the expertise of the staff, to share responsibility for school success and to build the capacity of the faculty and staff.
A study of 1,500 schools that were undergoing some form of restructuring found that involvement of teacher leaders in professional learning communities led to higher student achievement, lower dropout rates and improved behavior and attendance (Newmann and Wehlage, 1995). Principals need to be able to establish school structures and norms to foster the formation, success and sustainability of professional learning communities (Bryk and Schneider, 2002; Sergiovanni, 2004).

Teachers also play important roles as peer coaches, critical friends and professional development facilitators. Efforts to better support and leverage these roles are described in the section, Professional Development.

**Systems for Improvement**

Taken together, all of the functions of effective leadership—attracting and retaining staff, setting goals, diagnosing and designing improvements and leading instruction—represent a huge task. That is, effective school and system leaders create a climate for learning—for both students and adults. Who they hire, support and hold accountable and what challenges they focus on and how, including the extent to which they take a performance management approach (e.g., use data to assess and inform practice, conduct meaningful evaluations and provide task-specific feedback, develop an organizational learning culture), all have implications for who stays, how they perform and their level of satisfaction.

As U.S. Department of Education Secretary Duncan asserts, “There are no good schools without good principals. It simply does not happen.” But implicit in this is the notion that schools and districts have the system “intelligence” to lead effectively in the right directions. Leadership capacity is not only about the individuals serving as principals, regional executive specialists, senior staff, or the superintendent, but also about the quality of systems, processes and policies that affect human capital, information, technology and facilities management. The importance of data and data systems is recognized by the U.S. Department of Education, which identified it as one of its four key goals for creating innovation and supporting school improvement. According to the U.S. Department of Education, school districts and states need to make data accessible and use data to inform and engage key stakeholders in the decision-making process.

MPS is now well positioned for dramatic, data-driven school improvement. It has a vast and comprehensive data warehouse, has been a leader in value-added analyses and, has a common, district-wide assessment, grades PreK-12 in which all schools participate. These not only allow the district to effectively monitor progress in real time, but also to set school and grade-level specific SMART goals for schools and student progress, target support and ensure accountability for meeting them as needed. MPS also continues to provide high quality professional development in the interpretation and use of these data, as well as align School Improvement Planning processes, tools and strategies. Also of note, evolving data systems also allow MPS to track the allocation of central office staff support to schools (ART), coaching and other school-based
professional development, as well as participation in and impacts of professional development. (See the section, Professional Development, for more detail).

As MPS transitions from its historically decentralized system to one in which all stakeholders are clear about the district’s mission, purpose and instructional vision, as well as roles and responsibilities therein, considerable work is required. A plan for a more explicit, performance-based management approach (e.g., Six Sigma) is underway, including efforts to assess and improve human resource and information management systems and processes to provide more accurate and timely data. Cross-departmental, regionally focused, central service teams have been organized to support a “case management” approach to targeted school support. Perhaps most significant for CMSP implementation, instructional leadership is quickly becoming an area of emphasis for school leaders and teacher effectiveness and evaluation are increasingly at the center of reform discussions.

MPS understands that school improvement efforts must lead individuals to take responsibility for continuous improvement. It includes high expectations for the organization and aligned systems and supports, including benchmarks for work processes and systems set against industry standards, ambitious goals for staff and students and metrics to monitor and support achievement to them. To that end, MPS in partnership with the Milwaukee Teachers’ Education Association (MTEA), is developing a new, negotiated, tool for teacher evaluation that includes “teacher effectiveness.” Additionally, school-specific, performance goals, described earlier ensure targeted support and accountability for continuous improvement.
PROFESSIONAL DEVELOPMENT

As described by the Eisenhower National Clearinghouse for Mathematics and Science Education, professional development is a bridge, “…Each bridge requires careful design that considers its purpose, who will use it, the conditions that exist at its anchor points (beginning, midway and end) and the resources required to construct it” (2005).

The Comprehensive Mathematics and Science Plan is intended to provide a roadmap for improving mathematics and science education across all grades, schools and students in MPS. However, its successful implementation requires that all stakeholders, notably teachers, coaches and school and district leaders have the knowledge and skills necessary to ensure high quality implementation and improved teaching and learning.

Consistent with effective professional development, the CMSP professional development strategies focus on the knowledge, skills and dispositions required of all staff to support improvement of teaching and learning for all students to high standards. It likewise calls for a comprehensive, evidence-based approach—leveraging multiple strategies (e.g., intensive cohorts/learning communities, job-embedded coaching, on-line resources) supporting multiple stakeholders. The plan likewise includes a multi-tiered system of support in which both content and delivery are aligned to specific learning progressions and increasingly targeted to the needs of specific stakeholders (e.g., by role, grade-level, professional development goal, implementation progress).

The professional development plan includes three tiers of support:

- **Universal** expectations for support (e.g., district-wide professional development days, district-designed professional development modules delivered at the school level) and universal opportunities (e.g., workshop opportunities, on-line modules) ensure all teachers will participate in at least a common (e.g., by role, grade) six hours of professional development.
- **Strategic** support targets more intensive, cohort-based on-going professional development (30 hours or more per year).
- **Intensive** support for targeted schools and mentor sites emphasizes peer coaching.

Research shows that professional development is most effective when it is content specific and job-embedded, includes substantial contact hours sustained over time, allows multiple opportunities to engage in reflection and application and enables meaningful collaboration (e.g., professional learning communities). Unfortunately, such professional development is often the most difficult (and costly) to support and sustain at scale. As described in the following pages, a multi-tiered approach to professional development allows for more strategic resource allocation therefore preventing against spreading limited resources too thinly to make an impact, while also building capacity for deep and long-lasting reform.
Vision and Mission

Substantive improvement in mathematics and science learning requires not only substantive changes in how mathematics and science is taught, but also how professional development is designed and implemented to serve educators. MPS is committed to a learning plan design that integrates 21st Century skills into all curricular areas while building staff capacity in content knowledge (teaching, learning and assessment), leadership, communication and collaboration.

Background

Professional development fosters a collective responsibility for helping students and adults reach their fullest potential. The CMSP professional development plan is designed to impact the knowledge, skills and dispositions required of MPS educators in the 21st century to improve their practice for supporting student learning and achievement in mathematics and science. Exemplary mathematics and science programs are noted for developing and sustaining a professional culture of learning and an understanding for continuous improvement.

Professional development is not about programs. Professional development is about the learning, the work, the journey and the people (Bredeson, 2003). Acknowledged within effective professional development planning are the following belief statements:

- Learners are at different stages and have different needs.
- Learners have different learning style preferences.
- Learners' prior knowledge greatly influences their learning.
- Learners' motivation and opportunities for reflection are critical to the learning process.

Research increasingly finds that professional development can positively affect educator behaviors and student achievement, particularly when it focuses on: 1) how students learn particular content/subject matter, 2) practices related to the subject matter and how students understand it and 3) strengthening knowledge of specific subject matter. School and classroom conditions, including available resources, also affect impact (AERA, 2005). The plan that follows details an emerging, district-wide plan for ensuring a coherent, comprehensive, strategic, evidence-based approach to providing professional development in support of effective implementation of the Comprehensive Mathematics and Science Plan.

Consistent with effective professional development, the plan focuses on the knowledge, dispositions and performances required of all teachers, school leaders and other school and district employees to help all students achieve to high standards. The goal is to provide professional learning opportunities to support implementation of the Comprehensive Mathematics and Science Plan that can ensure:

- high performing urban educators in every classroom;
- effective leadership support for the CMSP in every school;
- continuous improvement in teaching and learning; and
application and follow through, using multiple measures, of professional
development in the classrooms.

Professional support in MPS is strategically tiered and targeted to the appropriate
employees based on needs and best practices. Multiple sources of data are used to
determine professional development needs, approaches and effectiveness and
Danielson’s *Framework for Effective Teaching: Components of Professional Practice*
serves as an organizing framework for supporting professional learning. This includes
four key domains of classroom practice (and teacher development), including: Planning
and Preparation, the Classroom Environment, Instruction and Professional
Responsibilities.

MPS has engaged with a number of community partnerships, including local universities
and colleges who collaborate with us to design and offer college level courses in content
for our teachers. These will be offered to mathematics and science teachers as part of
the CMSP professional design. Teachers need to constantly renew their content
knowledge and add to their knowledge as the field of study changes with emerging
technologies, discoveries and practices. It is critical that our elementary and K-8
teachers, especially, are allowed to expand their content knowledge and skills.

**Stakeholder Expectations**

As MPS embarks on an ambitious, district-wide, comprehensive plan to improve
mathematics and science instruction and student learning, the district is setting new
standards not only for students, but also for all adults charged with supporting their
academic success. All MPS employees must take responsibility for effective
implementation of the Comprehensive Mathematics and Science Plan. Likewise, the
district—from the central office to regional systems of support, schools and classrooms—
must be clear and consistent in its expectations and committed to high quality, strategic
support of all staff. For example:

Teachers (including teachers of students with disabilities) are expected to:

- understand the Comprehensive Mathematics and Science Plan, standards
  and expectations therein;
- actively participate in professional development and reflect on practices;
- implement the components of the Comprehensive Mathematics and
  Science Plan with fidelity (e.g., standards and curricula, instructional
  minutes, instructional/lesson design, assessments and related resources);
- use data to continuously monitor progress and improve;
- differentiate instruction based on students’ needs;
- help identify, ensure and monitor effectiveness of appropriate interventions
  for students who need additional support; and
- share expertise with others

School leaders are expected to:
• understand the Comprehensive Mathematics and Science, standards and expectations therein;
• create a positive climate for learning;
• make effective math, science and literacy instruction a high profile priority;
• facilitate appropriate structures and provide resources;
• support teacher learning, including through on-going, descriptive feedback to teachers and other staff;
• use data to continuously monitor progress and improve instruction and the school-wide learning climate;
• help identify, ensure and monitor effectiveness of appropriate interventions for students who need additional support;
• support implementation of the components of the Comprehensive Mathematics and Science Plan with fidelity (e.g., standards and curricula, instructional minutes, instructional/lesson design, assessments and related resources); and
• hold staff accountable and be accountable themselves.

Support staff, community members, families and other stakeholders are expected to:
• understand and support the Comprehensive Mathematics and Science Plan, standards and its implementation;
• help ensure students are prepared to learn, including through consistent attendance and committed to the learning process; reinforce math, science and literacy learning;
• help identify and leverage supports for individual students, classrooms, schools and the district;
• provide on-going feedback on implementation; and
• hold MPS accountable.

Framework and Guiding Principles
Professional support in Milwaukee Public Schools is strategically tiered and targeted to the appropriate employees based on needs and best practices. Multiple sources of data are used to determine professional development needs, approaches and effectiveness. Danielson’s *Framework for Effective Teaching: Components of Professional Practice* serves as an organizing framework for supporting professional learning. This includes four key domains of classroom practice (and teacher development) used to frame and observe practice, organize and reflect on professional development:

• Planning and Preparation
  o Demonstrating Knowledge of Content and Pedagogy Demonstrating
  o Knowledge of Students
  o Setting Instructional Outcomes
  o Demonstrating Knowledge of Resources
  o Designing Coherent Instruction
  o Designing Student Assessments
• The Classroom Environment
  o Creating an Environment of Respect and Rapport
  o Establishing a Culture for Learning
  o Managing Classroom Procedures
  o Managing Student Behavior
  o Organizing Physical Space

• Instruction
  o Communicating with Students
  o Using Questioning and Discussion
  o Techniques
  o Engaging Students in Learning
  o Using Assessment in Instruction
  o Demonstrating Flexibility and Responsiveness

• Professional Responsibilities
  o Reflecting on Teaching
  o Maintaining Accurate Records
  o Communicating with Families
  o Participating in a Professional
  o Community
  o Growing and Developing Professionally
  o Showing Professionalism

MPS’ structure and focus for district-wide professional development employs the underlying principles for high quality professional development based on the National Staff Development Council’s (NSDC) Standards, included in the Appendices. These standards, depicted in Figure 7 Theory of Change, recognize that sustained, rigorous professional development is essential for everyone who affects student learning. The NSDC Standards ensure that all professional development goals and strategies are connected to student, teacher and leadership needs and are implemented using research-based practices to impact student achievement and adult learning.

MPS uses the Danielson framework and the CMSP to help set a common vision of effective instruction and aligns professional development efforts to the Wisconsin State Standards for Teacher Licensure and the NSDC standards to ensure high quality support of the CMSP implementation. Strategies are designed to provide a structured, supportive and collaborative approach to promote instruction in mathematics and science and quality teaching within the components of professional practice (Danielson & McGreal, 2000).

The State of Wisconsin designed ten professional standards for educators, included in the Appendices, which focus on the knowledge, skills and dispositions required of teachers, administrators and other school and district employees to help students become proficient in the national core content standards. The teacher standards targeted include:
• **Teachers know the subjects they are teaching.**
The teacher understands the central concepts, tools of inquiry and structures of the disciplines she or he teaches and can create learning experiences that make these aspects of subject matter meaningful for pupils.

• **Teachers know how to teach.**
The teacher understands and uses a variety of instructional strategies, including the use of technology, to encourage children's development of critical thinking, problem solving and performance skills.

• **Teachers know how to manage a classroom.**
The teacher uses an understanding of individual and group motivation and behavior to create a learning environment that encourages positive social interaction, active engagement in learning and self-motivation.

• **Teachers are connected with other teachers and the community.**
The teacher fosters relationships with school colleagues, parents and agencies in the larger community to support pupil learning and well being and acts with integrity, fairness and in an ethical manner.

**Plan-Do-Study-Act**
As suggested earlier, even across stakeholders and level of support, there are some common features in district professional development, notably the focus on effective instruction embodied in Danielson’s framework and a commitment to continuous progress monitoring and improvement to meet the Danielson standards. In support of the latter, MPS is using the data-driven decision-making model, Plan-Do-Study-Act, Figure 7 below, to determine adult learning priorities, monitor progress and help sustain continuous improvement. Across the district, professional development continues to reinforce this approach, particularly in supporting instructional improvement and CMSP implementation.
Theory of Action

Given limited resources and an urgent need for impacted support, MPS professional learning opportunities are strategic in design and implementation. Efforts are developed to support learning across an implementation continuum (learning progressions)—from more foundational aspects of practice such as planning and preparation in year 1 around the mathematics practice standards and Next Generation Science Framework and instructional design to more in-depth understanding of mathematics and science content standards, instructional design and student interventions in years 2 and 3.

Professional development also varies in terms of intensity—frequency and duration, some on a more regular or repeat basis and with varying levels of follow up and continued support based on needs and goals. Professional development also varied in terms of delivery approach, where some efforts are large in scale as compared to others that include smaller group and one-on-one interaction with teachers or leaders. Activities also vary in the levels and nature of interactivity (e.g., one-way media-sites, facilitated workshops, model lessons, coaching) and structure (e.g., formal workshops, collaborative planning or data reviews, lesson study). Most significant among delivery approaches is peer coaching.

Academic mathematics coaches are assigned, trained and evaluated centrally with greater role definition that promises to improve their impact in targeted schools and classrooms. Likewise, district-level teaching specialists in mathematics and science
work with regional systems of support to not only support implementation progress monitoring and data analysis, but also to identify and target professional development support (e.g., facilitation of grade level meetings and/or school-based professional development) and work with specific school leaders and coaches (e.g., modeling).

**Tiered Support**

Effective professional development requires a variety of approaches and supporting roles. Likewise, the complexity of staff needs and appropriate design responses calls for differentiated professional development. Activities vary from those in universal support that are designed to reach all members of a particular group (e.g., K-8 teachers, high school teachers, principals, literacy coaches, central services staff) and develop consistent, foundational knowledge appropriate the specific roles and responsibilities of the participant to more customized learning activities aligned to the needs of specific subgroups and aligned to more in-depth support.

The professional development plan includes three tiers of support:

- **Universal support** (e.g., district-wide professional development days, district-designed professional development modules delivered at the school level) and universal opportunities and resources (e.g., workshop opportunities, online modules) ensure all teachers will receive a minimum of six hours of professional development over the course of the school year.
- **Strategic support** targets more intensive, cohort-based on-going professional development (30 hours or more per year) to:
  - Schools and classrooms based on need as reflected in fidelity of implementation and academic performance data (progress monitoring)
  - Early adopters, who will serve as advocates for and sources of feedback on CMSP implementation; whose classrooms will increasingly be expected to serve as mentor sites; and whose expertise and experience will support the design and facilitation of district-wide professional development for their colleagues
- **Intensive support** for targeted schools and mentor sites emphasizes peer coaching, including but not limited to support provided by math teacher leaders and teaching specialists who increasingly take a case management approach to targeting their limited time across sites.

Essential to ensuring universal support are district-led professional development days. These district-wide, all schools banking days allow MPS to bring together teachers from across sites to learn about key district initiatives and expectations, share their implementation challenges and successes and learn from and develop informal networks with job-alike colleagues Variations of this session will be similarly delivered to all principals, assistant principals, teaching specialists and coaches, special education supervisors and central services instructional support staff.

Implementation follow up includes school-based support from school leaders, coaches and regionally allocated, mathematics and science teaching specialists.
(focused on targeted schools). Though not always well leveraged in MPS, school leaders meet monthly with their staff before or after school to support instructional improvement. Among CMSP-related resources and professional development are content-specific supports to help principals and other school leaders better focus these professional development opportunities to align to and extend teacher learning aligned to district efforts.

Likewise, teachers are encouraged to participate in a limited number of voluntary professional development workshops during and after school and some Saturdays. These sessions provide for deeper implementation support in key areas (e.g., related to differentiation, use of specific materials in the instructional design). Additional resources are provided to support implementation without face-to-face support, including on-line learning communities, samples of classroom implementation, articles, etc., largely posted on the district website.

In contrast to this work, central service-based curriculum specialists have more specific, targeted plans of support (strategic and intensive), with greater levels of job-embeddedness for identified schools in each of the district’s five regions. Specific teacher professional development cohorts provide for more intensive and on-going support, particularly toward supporting “lead implementers.” Likewise, the district is working to develop a set of model CMSP implementation sites that require multi-layered support. Both the teacher cohorts and mentor sites promise to help develop the district cadre of CMSP experts as well as classrooms and experts that can serve as resources to other schools and teachers.

Among intensive supports and in addition to peer coaches as described above, MPS is also developing cadres of teacher leaders in both mathematics and science who will work first to improve their own classroom practices and become lead implementors in the areas of mathematics or science. As these teachers participate in more intensive and frequent professional development, learn, apply and reflect on new instructional strategies, district coaches will work to learn from their experience to continuously refine and reflect on available teacher supports (e.g., coaching design) and resources (e.g., videos of classroom practice, implementation guides) necessary to support improved implementation. As they continue to develop both individually and as a community of practice, it is expected that many will increasingly become resources to their peers—as critical friends, mentor classrooms and professional development facilitators. These specially trained teachers will also host classroom visits, develop model lessons, participate in professional networks, study groups and model self-directed learning for other educators.

In addition, the district is building a continuum of professional development support that aligns resources, prioritizes implementation strategies and emphasizes a case management approach to support educators. Staff is supported through a system of planned, coherent professional development that is standards-based, results-driven, relevant and improves the knowledge, skills and performance of all employees to improve administrative leadership, teaching quality, student achievement and district
Further description of the tiered system of support is included in the following table.

**Table 5: Tiered professional Development**

<table>
<thead>
<tr>
<th>Tier 1 (Core Content): Universal Expectations of Support</th>
<th>Tier 2 interventions: Strategic Support</th>
<th>Tier 3 interventions: Intensive Support</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Funding and ongoing support for centrally assigned mathematics and science teaching specialists and coaches</td>
<td>• <strong>Teacher Cohorts</strong> provide an opportunity for 1-2 teachers from each building to join a grade band specific professional learning community and receive 30 hours of professional development facilitated at the district-level by teaching specialists to develop and refine their skills as a <em>model</em> teacher in either Mathematics or Science.</td>
<td>Curriculum specialists and district teacher leaders will provide intensive <strong>school-based support</strong> and follow-up through:</td>
</tr>
<tr>
<td>• Provide to educators Mathematics and Science <strong>resources and tools on the MPS Portal</strong></td>
<td>• <strong>Focused training sessions</strong> provide skill development on a specific topic in behavior or support. The sessions are intended to support the practitioner (e.g., teacher, coach, school leader, etc.) in increasing effectiveness of implementing the CMSP strategies.</td>
<td>• Coaching</td>
</tr>
<tr>
<td>• <strong>Develop professional development opportunities</strong> that provides presentation and discussion on specific topics related to implementation of CMSP strategies including:</td>
<td>• <strong>Field study opportunities</strong> provide a chance for teachers to engage in experiential learning with mathematicians, scientists and engineers in the community.</td>
<td>• Modeling</td>
</tr>
<tr>
<td>o Standards</td>
<td>• <strong>Learning team training</strong> to further develop the skills, tools and best practices to support the fidelity of implementation of the CMSP.</td>
<td>• Mentoring</td>
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<td>o Instruction/lesson design</td>
<td>• <strong>Teacher Leadership (Literacy Coaches, Math Coaches, Instructional Coaches-Literacy and Mathematics and Department Chairs)</strong> will refine peer coaching skills in both one-on-one venues as well as with small groups with teachers on specific teaching strategies or problems, focusing on practical changes they can make in their classrooms. Facilitation skills will be further refined to support the successful delivery of professional development at the school level and to provide district level leadership and support.</td>
<td>• Professional learning community development</td>
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<td>o Differentiation</td>
<td></td>
<td>• Resource identification and alignment</td>
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<tr>
<td>o Assessment literacy</td>
<td>• <strong>Learning team training</strong> to develop teacher leadership in mathematics and science.</td>
<td>• Special education teachers Training in targeted interventions</td>
</tr>
<tr>
<td>o Use of instructional materials &amp; technology</td>
<td>• <strong>Teacher Leadership (Literacy Coaches, Math Coaches, Instructional Coaches-Literacy and Mathematics and Department Chairs)</strong> will refine peer coaching skills in both one-on-one venues as well as with small groups with teachers on specific teaching strategies or problems, focusing on practical changes they can make in their classrooms. Facilitation skills will be further refined to support the successful delivery of professional development at the school level and to provide district level leadership and support.</td>
<td>• Use of supplemental materials</td>
</tr>
<tr>
<td>o Tiered student interventions</td>
<td>• <strong>Learning team training</strong> to develop teacher leadership in mathematics and science.</td>
<td>• <strong>Learning team training</strong> to develop teacher leadership in mathematics and science.</td>
</tr>
<tr>
<td>• District supported Professional Development and Banking Days</td>
<td>• <strong>Teacher Leadership (Literacy Coaches, Math Coaches, Instructional Coaches-Literacy and Mathematics and Department Chairs)</strong> will refine peer coaching skills in both one-on-one venues as well as with small groups with teachers on specific teaching strategies or problems, focusing on practical changes they can make in their classrooms. Facilitation skills will be further refined to support the successful delivery of professional development at the school level and to provide district level leadership and support.</td>
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<tr>
<td>• Mathematics and Science Curriculum Guides and Instructional Pacing Guides and approved High School Courses</td>
<td>• <strong>Teacher Leadership (Literacy Coaches, Math Coaches, Instructional Coaches-Literacy and Mathematics and Department Chairs)</strong> will refine peer coaching skills in both one-on-one venues as well as with small groups with teachers on specific teaching strategies or problems, focusing on practical changes they can make in their classrooms. Facilitation skills will be further refined to support the successful delivery of professional development at the school level and to provide district level leadership and support.</td>
<td></td>
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<tr>
<td>• <strong>Learning team professional development</strong> to build skills and learn about using tools and best practices to support CMSP implementation at the school level</td>
<td>• <strong>Teacher Leadership (Literacy Coaches, Math Coaches, Instructional Coaches-Literacy and Mathematics and Department Chairs)</strong> will refine peer coaching skills in both one-on-one venues as well as with small groups with teachers on specific teaching strategies or problems, focusing on practical changes they can make in their classrooms. Facilitation skills will be further refined to support the successful delivery of professional development at the school level and to provide district level leadership and support.</td>
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<tr>
<td>• <strong>Teacher Leadership (Literacy Coaches, Math Coaches, Instructional Coaches-Literacy and Mathematics and Department Chairs)</strong> will develop peer coaching and facilitation skills to support the successful implementation of professional development at the school level</td>
<td>• <strong>Teacher Leadership (Literacy Coaches, Math Coaches, Instructional Coaches-Literacy and Mathematics and Department Chairs)</strong> will refine peer coaching skills in both one-on-one venues as well as with small groups with teachers on specific teaching strategies or problems, focusing on practical changes they can make in their classrooms. Facilitation skills will be further refined to support the successful delivery of professional development at the school level and to provide district level leadership and support.</td>
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</table>
Tiered System of CMSP Implementation Support Overview

<table>
<thead>
<tr>
<th>Tier 1 (Core Content): Universal Expectations of Support</th>
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</tr>
</thead>
<tbody>
<tr>
<td>school level and provide district level leadership and support.</td>
<td>• <strong>School Leader professional development</strong> on leading, communicating and evaluating school-based CMSP fidelity of implementation will be provided monthly to principals during their mandatory monthly professional development sessions.</td>
<td>• <strong>School Leader professional development</strong> on leading, communicating, evaluating and sustaining school-based CMSP fidelity of implementation and model classroom practices and behaviors will be provided during monthly professional development sessions.</td>
</tr>
</tbody>
</table>

**Goals and Objectives**

As in any education endeavor, success depends on the articulation and committed pursuit of specific, measurable goals. Professional development goals and objectives build on a clear, data-based statement of student and teacher learning goals. Stakeholders most likely to benefit from participation in professional development through targeted and universal strategies and supports are identified. Expected outcomes are articulated and evaluated for all professional development offerings.

Professional development goals have been established in the MPS Strategic Plan. Long-term measurable objectives for student proficiency in reading, mathematics and science remain the same, but others contained in the strategic plan were revised. The revised objectives reflect the theory of action and current assessments tools.

The intended outcomes for professional development will be defined in terms of improved professional practice, but the long-term goal remains the same--improved student performance and district operations. MPS uses the data-driven decision-making model, Plan-Do-Study-Act, Figure 7 to determine adult learning priorities, monitor progress and help sustain continuous improvement.

**Launch of CMSP: Systems of Delivery**

When school leaders across the district were introduced to the Comprehensive Mathematics and Science Plan (CMSP), they were given the opportunity to build upon their knowledge on instructional design, standards, assessments and instructional materials as they relate to the Comprehensive Literacy Plan and make connections to the CMSP. School learning teams had the opportunity to engage in a similar launch of the Comprehensive Mathematics and Science Plan with the expectation that they will assist their school leaders in introducing and supporting the CMSP at the school level.
**Parental Engagement**

The vision of the CSMP is to provide engaging learning activities in mathematics and science to support student achievement. Integral to this plan is the need for our children to actively know and learn about real world professional activities of mathematicians, scientists, technologists, engineers, doctors, nurses, pharmacists and many more individuals who work in field related to science and mathematics. The involvement of parents, guardians and other caregivers in these learning experiences is crucial to our students’ interests and abilities to learn mathematics and science. Many of the instructional activities, supporting the PreK-12 curriculum of the CMSP, help students understand economic, social and environmental issues for which we need to find solutions. These challenging problems are in such areas as health, energy, the environment, industry and agriculture. Parents and other caregivers play a critical role at home, in the school and throughout our community as they become valuable partners with our teacher to promote science and mathematics learning confidence and skills.

Both the National Council of Teachers of Mathematics (NCTM) and the National Science Teaching Association (NSTA) encourage parental involvement at home by promoting exploration and discovery. Both associations understand that successful parent-family involvement programs will result in:

- increased student achievement and attendance and a decrease in the drop-out rate;
- greater parental-family participation in school activities; and
- improved school climate that is friendly and accessible.

Supportive parent-family programs, therefore, create an equal partnership between our teachers, parents and families and our community (Kruger, 2001).

**Family Partnership Roles**

When teachers and administrators communicate the support needed to meet the goals of the CMSP, parents and other family members can determine what is their ‘best-fit’ for participation. These roles may include such activities as:

- assisting students and classrooms with community-based mathematics and science problems and projects;
- serving as mentors to other students outside of their immediate family;
- supporting field trips and visits to museums, nature centers, hospitals, pharmaceutical labs and local businesses;
- monitoring and supporting homework, learning logs, science and mathematics activities at home; and
- serving on school or district committees on topics such as policy or curriculum or the CMSP advisory committees (Kruger, 2001).

MPS has strongly supported such as activities as mathematics and science family/community nights in many of our schools; annual science fairs; student participation in math competitions; and other activities where parents and families can learn the tools needed to become mathematics and science coaches for our children.
Parental involvement in homework

Homework is often found to be the link between school and home. “While some parents or guardians view homework as an opportunity to become involved in their child’s education, others view homework as a source of stress for the child and parent” (Harwell & Grown, 2009). Parental involvement in mathematics and science homework, unfortunately, has often created stressful relationships between child and parent. Many families, not only in Milwaukee, but all across our nation, believe that they are not sufficiently mathematically or scientifically literate so that they can help their child. Few families have members who actually use mathematics or science skills and concepts on a daily basis.

Underlying the guiding principles of the CMSP is the rationale that parents and other family members will renew their knowledge and understanding of the mathematics and science programs taught in our schools. For example, using literature as a basis for home-based mathematics and scientific inquiry and hands-on projects and providing workshops for parents as new mathematics and science textbooks are adopted will link mathematics and science to the home. Motivation and engagement is also improved by through clear instructions and necessary materials (Ferguson, Steele, & Witzel, 2008). When such activities are implemented, district-wide, at-home participation in mathematics and science activities, teacher appreciation of parents as partners in the learning of mathematics and science and positive student perceptions of parental involvement will increase.

Becoming a Partner

Parents and other family members can partner with our CMSP classrooms and schools in various ways. Such possibilities are listed below, many of which are already taking place:

- Communicate with teachers to learn about children’s mathematics and science learning opportunities and performance.
- Encourage children to participate in extracurricular opportunities focused on science, technology, engineering and mathematics such as clubs, field trips, after school programs and mathematics/science research competitions.
- Seek out opportunities to meet and get to know teachers of mathematics and science teaching the CMSP. Volunteer in the classroom or on a field trip; serve on a science curriculum review or policy development committee; or attend a school’s open house or family science night event.
- Be informed about the science program at our CMSP schools. Learn more about the school's CMSP curriculum and the amount of time devoted to mathematics and science learning and hands-on activities by finding out if teachers have the necessary resources and experience to teach mathematics and science effectively.
- Become involved with the local school board to ensure that mathematics and science learning is a top priority in the school system and that adequate resources are available.
• Establish high expectations for mathematics and science learning.
• Be an advocate for mathematics and science learning by supporting local, state and national science education policies and investments in resources, including school curriculum materials, laboratory equipment and teacher and administrator professional development.
• Reach out to policy makers to impress upon them the value of mathematics, science and technology learning and its importance to your children's future (NSTA, 2009).

Parents and other caregivers play an important role in ensuring that our children have the necessary knowledge and skills in mathematics, science and technology to become scientifically literate and informed citizens. The mission of the CMSP is to develop a strong mathematics, science and technology-skilled workforce. Parents can encourage children to consider and pursue mathematics, science and technology careers that are certainly within their reach as they learn the necessary knowledge and skills that will allow them access to and success in such careers.

Parents and other family members can assist in this progression of learning about 21st century mathematics, science and technology by introducing their children to members of the community whose work relates to mathematics, science or technology - trades and professions such as construction or manufacturing, public safety, medicine, natural resource management, or research. MPS encourages parents to “Take Your Child to Work” days so that they can experience firsthand how mathematics, science and technology are used in their workplace. Parents can attend career fairs with their children to seek out opportunities in mathematics, science and technology by helping them to explore a broad range of career options.

Our local colleges and universities are great places to visit to meet mathematicians and scientists and to find mentors that pair students and mathematicians and scientists to carry out hands-on mathematics and science projects. Milwaukee and Milwaukee County is a great resource for non-school experiences in mathematics and science by visiting museums, libraries and the Milwaukee County Zoo. By building these relationships with scientists, mathematicians and technologists in our community and supporting the CMSP, children will no longer believe that mathematics and science is not a career for them – rather they will understand that anyone can have a career in science, mathematics or technology and be able to enter that field with confidence and determination to pursue their interests.

Make Math Interactive
The kitchen is a great place to learn about quantities and proportions. Two small bowls make one large bowl. Ask a child to bring you four of something is a great way to begin reinforce basic counting. The children are proud to help and they are learning about numbers. Children can also help measure and count ingredients for simple recipes. Provide children with trays with buttons, beads, feathers and other interesting objects and let children sort by size or shape, or group a certain number of objects. With an assortment of boxes and lids, children can match sizes and shapes. They can make
matching pairs from magazine pictures and egg cartons cut in half or a pile of different colored socks, mittens, or shoes. Feely bags with different-sized blocks, small toys, or outside objects let children learn to identify and describe objects based on touch. Provide children with a kitchen timer, an egg timer, a scale, a ruler, measuring tape and a thermometer and they are able to explore weight, length and time.

**Engage Children in Science**

When teaching children about science there are four basic questions you should ask: “What is this?” How would you describe it? Why is it important? What would happen if we didn’t have it? Experts recommend having children do simple science experiments using objects from their everyday world. For example, experiment with different fruit to see what will float or sink. Children will learn about density and why fruits float (so the seeds disperse more easily), as well as grouping and classifying. Ordinary activities can take on new meaning when children learn about the science behind them.

**Techniques for Parents**

- When your child asks a question, respond by saying, “That's a good question. What do you think?” or “How can we find out?”
- Show interest in and listen to your child’s questions and activities.
- Discuss activities before, during and after doing them. Encourage your child to explain what she is doing and why as she goes along.
- When you ask a question, give your child plenty of time to respond. Ask open-ended questions rather than yes or no questions only.
- Encourage your child to make predictions, make comparisons and draw conclusions.
- Don’t pretend that you know the answer and don’t feel badly about not knowing. Show your child how to go about finding an answer.
- Ask your child questions about her answers whether they are correct or not. Ask her, “What made you think that?” or “How did you get that answer?” before you tell her an answer is right or wrong. (Pearlman & Pericak-Spector, 1992; Great Explorations in Math and Science, 1991)

**MPS Parent Information Center Responsibilities and Priorities Related to Mathematics and Science**

- Provides parents with access to a wide range of information, knowledge and skills, which will enable them to be collaborative partners in the education of their children.
- Facilitates parental involvement at the school community level. For example, schools that need to increase parental involvement and satisfaction may request the assistance of the center.
- Collaborates on parent involvement activities for ESEA Title I programs.
- Provides assistance and support to increase parent participation and collaboration about their children’s education in the areas of special education and Title I, ESEA services, No Child Left Behind and free tutoring.
- Increases parental satisfaction related to the delivery of educational services.
• Provides information related to ongoing MPS initiatives, including the Comprehensive Mathematics and Science Plan.

<table>
<thead>
<tr>
<th>District Approved and Supported Parent &amp; Family Involvement Strategies for Mathemati cks and Science</th>
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<tr>
<td>In order to empower parents and families, there are multiple opportunities, district and school based for parents and families to receive information and participate interactively to support student achievement in the home environment.</td>
</tr>
<tr>
<td>These activities include but are not limited to:</td>
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<tr>
<td>• English and Bilingual parent literacy trainings on standards and assessments including beginning of the year/screening information</td>
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<tr>
<td>• English and Bilingual parent literacy classes and ESL classes</td>
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<tr>
<td>• Implementation of Home Instruction for Parents of Preschool Youngsters (HIPPY) and Having Involved Parents (HIP) at 35 MPS schools</td>
</tr>
<tr>
<td>• Take-home-math and science kits for families</td>
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<tr>
<td>• Explanation and review of assessment data</td>
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<tr>
<td>• Communication about mathematics and science through newsletters, websites, etc. in multiple languages</td>
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<tr>
<td>• Workshops for parents on various ways to help their children learn mathematics and science</td>
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<tr>
<td>• Parent-teacher-student conferences on mathematics and science goals and assessments</td>
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<tr>
<td>• Parent and community involvement as external assessors; providing effective feedback</td>
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<tr>
<td>• Weekly interactive mathematics and science activities/strategies to support schools</td>
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<tr>
<td>• PTA/PTO parent center/family room to provide activities in mathematics and science for children</td>
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<tr>
<td>• Partner with businesses for donations</td>
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<tr>
<td>• Access to the parent involvement calendar on the public page of MPS which includes various workshops and other trainings that extend classroom learning to the home environment</td>
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<tr>
<td>• Parent involvement specialist assigned to each cluster</td>
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<tr>
<td>• Parent coordinator assigned to each school</td>
</tr>
<tr>
<td>• Two (2) parent resource centers</td>
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<tr>
<td>• Governance council at all schools</td>
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</tbody>
</table>
STRATEGIC COMMUNITY PARTNERSHIPS
Business and community partnerships play a critical role in helping to assure that MPS students are prepared for college, career and life. Many business and community partners are eager to work to make a difference for young people in their transition to adulthood, starting from a very early age. Creating classroom/school-business and community partnerships is an effective way to leverage a variety of external resources (e.g., field experiences, speakers, professional development opportunities, instructional materials, expertise) to better engage students and staff in mathematics and science learning. Effective partners share the belief that every child can learn and become a productive citizen. As allies in the education of our youth, external partners can play an important role in enhancing their educational experience. MPS partners must be dedicated to a long-term commitment to our schools, during which time they should be prepared to offer guidance, encourage higher education, promote internships and careers and keep teachers informed of current trends in the business community. As the world becomes more sophisticated both socially and technologically, it is imperative that our students are equipped with the requisite skills and knowledge base that they need to succeed both inside and outside the classroom. Partnerships create value for businesses looking to build a pipeline for future talent, to engage their employees, increase community involvement and to help teaching professionals learn more about the world of work.

For schools, the partnerships strengthen the connections to the “real world” for classroom activities, maintain currency for teachers in their chosen fields and provide resources for students and classrooms – from materials, to information to actually financial support. Partnerships help to generate student excitement to learn and pursue their dreams. Partners can assist schools in encouraging student goals for higher education and promoting positive relationships for community involvement.

High functioning partners have excellent communications between all partners – students, teachers, families and the partnering organization. Long-term commitment from partners can vary, but the commitment to common goals with schools help sustainability.

MPS builds partnerships on both a short- and long-term basis involving partners in school and district wide activities, career fairs, classroom experiences, field trips, internships, job shadowing for both students and teachers, work based learning placements, program advisory boards, curriculum resources, college connections, service learning, equipment and supply donations and financial support.

Framework for Effective Partnerships
To ensure alignment of partner supports and significant progress toward goals for improved mathematics and science teaching and learning, partners need to have the expectation of a “mutual flow of contributions and benefits” (Baumgartner, 2010). The first step in this process is to determine the mutual benefits for the district, school, or classroom and the partner, i.e. what are the unmet needs and whether or not forming a business or community partnership would enhance engagement of students in the classroom.
There are key elements that the CMSP will use in implementing business and community partnership based on national best practice and local history. These elements include: planning, communications, mutual visioning, shared decision-making and flexibility. The following outlines steps in creating a partnership:

- **Plan together from the start**
  - Assess the strengths of the partnering organization and its employees
  - Assess the capacity: How much time can be devoted to face-to-face interaction?
  - What are the strengths and needs of the school?

- **Clarify the Vision**
  - We work in partnership in order to accomplish goals that can’t be met alone
  - Agree on a mutual vision?
  - What is the over-arching purpose?
  - Agree on long-term aspirations

- **Take time to get to know each other (processing)**
  - Teachers and partners spend time on-site, during regular hours of operation
  - Helps to understand each others’ core competencies and day-to-day challenges

- **Set ground rules**
  - Jointly develop ground rules for working collaboratively
  - Who will lead meetings?
  - How will problems be addressed?
  - How will information be communicated to stakeholders?

- **Start small and build gradually**
  - Important to identify some “quick wins” that engage and get partnership off to great start
  - Will involvement be monthly, bimonthly or semi-annually?
  - Gradual increase of activities and more predictable schedule = formation of relationship

- **Clarify roles and responsibilities**
  - On-going, clear communication is paramount!
  - Jointly develop a written plan of action

- **Share decision making**
  - Make sure all stakeholders have input and are asked for feedback
  - Division of labor developed

- **Prepare team members to work together**
  - Develop strategies that help partners learn more about each others’ world
  - Classroom management tips
  - Real world vs. classroom environment
  - Talk to or visit partners who are already involved

- **Stay Flexible**
  - Be open to change, improvement and others’ ideas
  - What has worked well? What needs to be changed/discontinued?

- **Be Strategic**
  - Listen and observe carefully
- Be open to the on-going needs of all partners, for they bring new opportunities
- *Share your success*—for it inspires more success!

**Strategies for Partner Engagement**

Corporate Voices for Working Families, working together with the Forum for Investing in Youth, have developed the Business Engagement wheel shown in the figure below. This tool assists MPS and individual schools in identifying partners, the avenues for those partners to work with MPS schools and the roles for different partners to play based on the common goals and values established in the elements above.

The wheel has three separate rings, each with a different purpose. The inner ring shows the categories in the business world to use for outreach. The middle ring shows the avenues or ways to reach out and connect to partners. And, the outside ring lists the different roles that partners can fulfill working with the district. Successful long-term business partnerships provide multiple types of opportunities for engagement and provide business leaders with a menu of options for their involvement. The partnership options that follow can provide the base for that menu.
Coordinating and Creating College-University Partnerships

Essential for effective and meaningful mathematics and science education in MPS is the development and coordination of strong PreK-12 partnerships with colleges and universities. Coordination between teachers of the CMSP and college/university instructors of mathematics and science enables both groups of educators to address the curricular, instructional and assessment goals of the CMSP.
Milwaukee and southeastern Wisconsin has a significant number of colleges and universities. The CMSP allows for existing and new partnerships with higher education to flourish in support of improved mathematics and science education. Aspects of these partnerships and collaborations include:

- consultation with MPS and its schools to create and foster a college-going culture that emphasizes the importance of knowing mathematics and science so that our students are academically prepared,
- consultation with MPS and its schools to ensure that students are career and college ready in mathematics and science, including the creation and distribution of multi-lingual materials in mathematics and science,
- creation and distribution of electronic and printed tools and materials in mathematics and science that enhance a college-going culture,
- providing opportunities for MPS students to explore future fields of study and work through visits and experiences on campus of local colleges and universities,
- providing professional development on engaging instructional strategies and aligned resources for raising student expectations of their abilities in mathematics and science to ensure successful student transitions between school levels from Kindergarten to College and
- supporting MPS schools with evaluation strategies that help teachers maximize their CMSP resources and apply the college and/or university’s research expertise to the everyday needs of teachers, families and communities.

Many institutions of higher education, especially universities, are strongly research-focused. MPS recognizes the value of using classrooms as an environment for applied research. Throughout the entire CMSP process – from the planning and development to implementation and assessment of the CMSP, MPS recognizes that non-obtrusive, ethically sound research by qualified researchers positively contributes to stronger classrooms using the most up-to-date instructional strategies, assessment tools and resources in mathematics and science. Partnerships provide MPS with in-kind support in the form of materials (e.g. computers, lab equipment, etc.), tutoring for students, guest speakers or seminars for teachers and courses for mathematics and science teachers to improve their content knowledge and skills. These relationships are built upon reciprocity.

**Connecting with Businesses**

CMSP and business/community partnerships in the Milwaukee Public Schools can provide models of thinking and working with formal mathematical and scientific systems. Through CMSP community partnerships, all students gain exposure to real world applications of mathematical and scientific knowledge and skills through experiential learning opportunities. At the end of the 20th century, corporate America identified the education of students in mathematics and science as a significant challenge to the provision of productive workers and citizens for the 21st century. Bringing business and community leaders together with parents, students and teachers in schools provides the
context and real classroom experiences to ensure alignment with standards and workforce skills to strengthen students’ mathematical and scientific literacy.

Connecting the world outside of the classroom to the teaching and learning of mathematics and science in MPS constitutes an integrated partnership between K-16 educators and the local/national community. The National Alliance of Business (2007) and the National Sciences Resources Center provides a model for what partners can do to change the direction of mathematics and science education. This model shows varying levels of partnerships from the classroom level to the policy level. With this model in mind, MPS has identified several opportunities for community partners to support the CMSP:

- join national, state, school, MPS organizations which are leading education reform;
- participate in the development of the MPS strategic plans and school improvement plans;
- help maintain the CMSP vision and mission;
- be an MPS school board member;
- help integrate new business trends into quality management of the MPS;
- participate in facilitating professional development for mathematics and science teachers;
- be a content resource in mathematics, science, technology and engineering.
- Participate with school-based educators in learning research-based teaching practices;
- volunteer regularly in classrooms;
- model the inquiry process to students and teachers in a classroom visit;
- be a content resource for individual teachers;
- communicate your passion for math and science to teachers and to the public;
- be an advocate for continuous improvement in mathematics and science teaching and learning;
- write letters to the editors of local newspapers to inform the public on the importance of community partnerships and specific partnership support of MPS; and
- lead family mathematics and science activities.

MPS Business and Community Partnerships (Central Services Support)
MPS Business and Community Partnerships Services (BCPS), located in the Office of the Superintendent, works to connect the greater community to the Milwaukee Public Schools on both the district and individual school level. BCPS supports schools and helps improve student achievement by bringing financial and human resources to MPS. These resources, which may be in the form of volunteers or monetary support or partnerships, focused around key district academic programs. Several effective community partnerships currently exist to support our vision for mathematics and science--preparing every student to be mathematically and scientifically literate and improving student achievement to high standards for college and career readiness.
These partnerships include:

Learning Journeys

Learning Journeys are new, highly developed, beyond the classroom, learning experiences that connect standards-based, classroom instruction for MPS students with real-world learning opportunities at Southeastern Wisconsin's finest museums, cultural experiences and scientific venues. Every MPS student grades K4 through eighth grade will have the chance to experience these opportunities—a unique one is offered each year—during their elementary and middle school years. These experiences will allow students to see the opportunity around them and in the community they call home by experiencing real-world learning events happening in their communities every day. In addition, they will be exposed to these cultural and civic resources at an early age, which helps to create the next generation of patrons to value and support these important institutions.

Each Learning Journey is grade-level specific and ties back to MPS core standards, curriculum and teaching and learning goals. The Learning Journeys move learning from the classroom into the greater community where students have the chance to have hands-on learning experiences, engaging their senses and imagination. Also included are pre and post-test materials so teachers can prepare students to fully benefit from the Learning Journey before the experience and apply what they learned after participating in the experience.

The pilot "Where We Live" Learning Journey is in partnership with Discovery World. Beginning in January 2012 fourth grade students will explore the Great Lakes Future, City of Fresh Water, Badger Meter Liquid House and Reiman Aquarium exhibits at Discovery World. They will participate in an interactive discussion about the importance of the Great Lakes to the greater Milwaukee community and create a product that focuses on the importance of water. They will work at hands-on stations to reinforce the science concepts and experience, first-hand, the lake shore of Lake Michigan. This Learning Journey has a strong science component and is a key learning component of the Comprehensive Mathematics and Science Plan. The "Where We Live" Learning Journey helps fourth graders connect to classroom earth sciences instruction through study and exploration of the Great Lakes.

CMSP Community Advisory Committee

A major effort began in February 2011 as part of the development and implementation of the CMSP. A CMSP Community Advisory Committee was formed as a way to involve the community representing each of the key stakeholder groups—students, parents, teachers, school leaders, higher education, community organizations and business and industry in the development of the plan. Each CMSP Community Advisory Committee member, approximately 75, serves on one of three committees: Communication, Community Engagement and Partnership and CMSP Input and Feedback. Each of the committees is chaired by an MPS employee and a community member.
The goals of the CMSP Community Advisory Committee are to:
- be the Community Ambassadors for CMSP efforts;
- understand the common aligned consistent curriculum that is needed to improve student learning;
- champion Change for the Children approach; and
- provide continuous feedback and improvement of the CMSP through the development and implementation cycle.

The Communication committee develops “key messages” for MPS staff and community partners to us to share important information about the CMSP. They work with members of the Community Engagement and Partnerships Committee and other school and community members to ensure that all are able to serve as “community ambassadors” sharing information and progress being made by MPS and GE Foundation Developing Futures Programs.

The Community Engagement and Partnerships committee identifies ways that the community can be involved to support students and staff in MPS. They are charged to select high impact engagement strategies, develop plans to implement them and assess their effectiveness. This committee serves to seek a broad range of community partners who are willing and able to support the children in Milwaukee through the CMSP.

The Input and Feedback Committee reviews the state, district and GE Foundation expectations for the CMSP. They provide input to the plan development, revision, implementation and monitoring efforts.

Most significant about the CMSP Advisory group is the role it plays in bringing together three formerly isolated district-community coalitions in mathematics, science and CTE/STEM education. These include the Milwaukee Mathematics Partnership, Milwaukee Science Coalition and the MPS STEM Partners, each of which is described below.

**Milwaukee Mathematics Partnership**
The University of Wisconsin-Milwaukee, the Milwaukee Public Schools and the Milwaukee Area Technical College comprise the Milwaukee Mathematics Partnership. As a member of the Milwaukee Partnership Academy, a community-wide collaborative PK-16 effort among school, university, union, government, business and community organizations, the Milwaukee Mathematics Partnership seeks to substantially improve mathematics achievement for MPS’ 85,000 students.

The Partnership involves mathematics faculty and mathematics educators in collaboration with PreK-12 educators in strengthening district curricula, student assessment measures and re-designing pre-service and in-service teacher preparation focused on the needs of an urban district. Through this Partnership, the Institutions of Higher Education Mathematics Network, consisting of 2- and 4-year colleges and universities, was established to focus on the mathematical preparation and continued
growth of PK-12 teachers and to improve the transition of students to post secondary education. The Partnership embraces four major goals in order to improve student achievement:

**Comprehensive Mathematics Framework:**
Implement and utilize the Comprehensive Mathematics Framework to lead a collective vision of deep learning and quality teaching of challenging mathematics across the Milwaukee Partnership. Strategies include PK-12 student Learning Targets and Model Performance Assessments, alignment of high school coursework with college expectations and increased enrollment and success in challenging mathematics courses, including Advanced Placement and International Baccalaureate mathematics courses.

**Distributed Leadership:**
Institute a distributed mathematics leadership model that engages all partners and is centered on school-based professional learning communities. Strategies include math teacher leaders, school-based learning team, Principal Mathematics Leadership endeavor and district mathematics leadership.

**Teacher Learning Continuum:**
Build and sustain the capacity of teachers, from initial preparation through induction and professional growth, to understand mathematics deeply and use that knowledge to improve student learning. Strategies include the IHE Mathematics Network; Design Teams focused on core mathematical preparation for all PK-8 teachers, an elementary mathematics minor and a secondary mathematics capstone course; teachers on special assignment as Teachers-In-Residence at the university; teacher recruitment; content-focused induction; and school-based professional learning communities.

**Student Learning Continuum:**
Ensure all students, PK-16, have access to, are prepared and supported for and succeed in challenging mathematics. Strategies include School Educational Plans, mathematics alignment for the Tutoring and Family Literacy Initiative and Transitioning to College Mathematics effort.

**Milwaukee Science Education Coalition**
Milwaukee Science Education Coalition (MSEC), launched in September, 2008, is a professional learning community of science educators in the Milwaukee areas. Members include informal science education organizations, higher education institutions, businesses and community organizations that provide science education opportunities for students and teachers in MPS. Currently, there are 51 actively participating organizations or individuals representing museums, nature centers, projects, corporations and city and state government. The purpose of MSEC is to improve the science literacy of students and families in Milwaukee Public Schools and the greater Milwaukee area through community-based partnerships.
MSEC offers experiential learning outside the walls of the classroom for students and professional development for science teachers to improve student achievement in the disciplines of science. The scientists as partners work with students and teachers on the application of good scientific process—not the step-by-step approach of the scientific method, most students are taught, but the real scientific skills of experimentation. The science educators of MSEC work with teachers to understand science content and develop pedagogy.

**MPS STEM Partners**

Science, Technology, Engineering and Mathematics (STEM) education in Milwaukee Public Schools is central to the future of our city’s youth and employers alike. The MPS STEM Partnership was formed to promote educational programs and events in MPS as a positive attribute in our community. Coming together as a direct result of the first “sySTEMnow” conference in 2004, MPS STEM Partners has provided opportunities for Milwaukee’s business community to interact with MPS students on meaningful STEM projects and activities. The partnership has grown to over 40 active businesses and post secondary partners, exposing MPS Students not only to STEM-related educational pathways and career opportunities, but also providing the local face of potential employers.

In addition to assisting teachers in the delivery of the curriculum-based Project Lead The Way program, MPS STEM Partners support a wide variety of extra-curricular STEM activities and programs. These interactions allow MPS students to broaden their exposure to STEM, expand their knowledge, demonstrate their problem-solving abilities and enhance their teamwork skills. MPS STEM Partners are proud to represent these efforts to the community at large.

**District Resources/Divisions**

**Mathematics Education Services**

The vision of the MPS Mathematics Education Team in the Department of Curriculum & Instruction is to support and enhance the teaching of mathematics to improve student learning and understanding of mathematics. We aim to improve the teaching and learning of mathematics by facilitating critical school-based and district-wide targeted professional development opportunities throughout the district that are based on the most recent research on best practices, curriculum and assessment. The mathematics teaching specialists (teachers assigned to central services) participate in schools’ leadership teams and support them in their development of the School’s Improvement Plan. The specialists are also responsible for demonstrating and modeling effective teaching strategies for teachers in their classrooms based on research-proven practices in the Comprehensive Mathematics Framework. The mathematics division staff also develops and implements formative assessment tasks and tools for the purpose of informing instruction. Our goal is to provide support for teachers to build individual confidence in their abilities to understand and facilitate effective mathematics instruction for all students.
Science Education Services
The Science Education Team in the Department of Curriculum & Instruction is responsible for science education, Pre-K to 12th grade in MPS. The team provides leadership, service, support and professional development to school-based and district-level instructional leaders and groups of classroom teachers in the areas of curriculum, instruction and assessment. Their services include connecting schools to community partners and resources to expose teachers and students to experiential learning opportunities. They also identify science materials and resources for schools and routinely share important science information with teachers and administrators. Science Education is responsible for conducting chemical hygiene and safety audits in schools. The team consists of a curriculum specialist and three science teaching specialists.

Career and Technical Education Services
Career and Technical Education (CTE), reporting to the Chief Academic Officer, develops and supports career-themed curriculum, work-based learning and community partnerships to prepare students for post-secondary education and careers in the 21st century. CTE utilizes project-based, problem-solving teaching and learning; promotes 21st Century technology in all classrooms, operates programs of study in high wage, high demand and high skill fields; builds workplace, community and post secondary collaborations; connects workplace learning with the classroom and provides continual professional development for teacher effectiveness and content expertise.

The value and efficacy of the CTE division is underscored by its accomplishments in increased student attendance and graduation rates and improvements in post-secondary outcomes. Studies have shown that student enrollment in CTE significantly increases student engagement, decreases dropout rates and motivates students to persist to graduation. In 2009, CTE concentrators in MPS showed an 88.7% graduation rate. CTE provides students with the opportunities to gain critical math, science and literacy skills in a relevant context – utilizing principals of project based learning and exploration. A study by the National Research Center for Career and Technical Education discovered that when combining professional development with a pedagogic framework to identify and teach mathematics that is inherent in CTE curricula, students who received the enhanced instruction scored significantly higher on standardized math tests than students who received their regular curriculum (Stone, Pearson, Lewis, Jensesen, 2006). At the same time, scores on technical assessments did not decrease – showing that a high quality contextual approach to improving academics could produce very valuable payoffs for students and their future career prospects.

Library Media Services
“Today's school library media program plays an integral role in educating children for the future. It is where students learn to find, analyze, evaluate, interpret and communicate information and ideas--skills they will need as adults to live and work in an information-based society. In addition to serving as independent learning centers, the programs of many centers are directly integrated into the curriculum” (American Association of School Librarians, Partner in Learning).
In keeping with the spirit of the American Library Association the vision of the MPS Library Media Services is to promote quality library media programs that lead to high student academic achievement. We also believe that highly trained and qualified library media personnel are essential to providing meaningful library experiences to students, staff and families. Further, it is our belief that library media centers that are diverse and culturally relevant positively support the characteristics of high performing urban classrooms.

Preparing students to be successful in the 21st Century is going to take a collaborative effort. The library media center is the vehicle that supports staff and students as they strive to become effective users of information. Library media specialists must work in tandem with teachers to align their curriculum to MPS Targets, State Standards and the Information and Technology Strategic Plan. According to the Wisconsin Study on School Libraries, schools where library media specialists spent more time on instructionally related student and teacher activities and were successful in building collections that provided a wide range of quality resources had higher WKCE scores. High performing library media centers also use school data to assess the impact of the library on achievement and they continually evaluate and collect data that can be used to create lessons and inform their practice.

Our mission is to promote collaboration between library media staff, classroom teachers and other specialists to enrich student-learning experiences and ultimately close the achievement gaps. The Teaching and Learning district library media specialists are committed to supporting and training highly qualified library media personnel. In addition, it is our resolve to provide leadership to establish quality library media programs and to work toward developing 21st Century library media personnel, collections and facilities.

**Bilingual/English as a Second Language (ESL) Services**

The Bilingual Bicultural Education Program offers a variety of options to all language minority students through various schools across the city. The program models used in MPS include the following: Developmental / Maintenance program, Dual-Language program (Dual Immersion or two-Way) and the English as a Second language (ESL) Stand Alone program.

*The Bilingual Developmental program* is for Spanish speaking students in kindergarten through twelfth grade. This model assists students to achieve the skills of understanding, speaking, reading and writing in two languages, one of which is English. The premise is to foster continued development and retention of a child’s literacy skills in their native language and to utilize the language as a vehicle for exploring and acquiring a second language. Therefore, while the students are building the necessary academic skills in their native language, the students are able to naturally transition into the second language at their developmental level in second grade, second semester and therefore, transfer these literacy skills into the second language (English). The classes are taught bilingually, utilizing the regular subject content textbooks and other supplementary instructional materials in Spanish and English. At the secondary level, the proficiency
level of students in each classroom will dictate the required amount of second language instruction. The goal being that students are instructed in their second language at least 60% of their class period.

The Dual Immersion model fosters a second language in minority students at the same time that it fosters a second language for the main population of a country, in this case, English speaking students learning Spanish as a second language. In this model, English and Spanish speaking students are enrolled in the same classroom.

English as a Second language (ESL) services are offered throughout the district as both a component of the Bilingual (Spanish/English) Program as well as to other language minority students that attend ESL stand-alone schools. For both programs, classes are taught by certified ESL teachers at various schools in MPS at the PreK-12 level.

ESL is an integral component of the Bilingual Program; both ESL and classroom teachers are responsible for the student’s English language instruction. The ESL classes are taught utilizing a content-based team teaching approach. The Instructional approaches for ESL in the bilingual classrooms parallels pedagogical methodology of mainstream classes in content areas and the State Standards are utilized for instruction and achievement. The ESL teachers derive language objectives using The WIDA® Consortium’s English Language Proficiency Standards for English Language Learners (ELLs) in Pre-Kindergarten through Grade 12 to ensure that ELL students are receiving the appropriate English content vocabulary according to their individual English language proficiency (ELP) level and are typically grouped in ESL classes according to age. A variety of service delivery models based on student needs are practiced including pullout, team teaching, push-in etc.

ELL students not enrolled in the Bilingual Program are placed into monolingual classrooms. Hmong, Somali and Arabic students receive native language support from bilingual teaching assistants and teachers when possible. Since students are immersed in a non-bilingual program, extra ESL support is helpful to the child’s well being and academic growth and is encouraged. Integration of ESL and classroom instruction implemented through team-teaching is recommended where feasible, especially for students at the intermediate and advanced stages of English language acquisition.

Special Education Services
The Individuals with Disabilities Education Improvement Act 2004 (IDEA) requires that each student with a disability receive an individualized program of specialized instruction and support services that is appropriate to his or her unique educational need. The Individualized Education Program (IEP) team makes all decisions regarding to placement and programs. The IEP team begins under the premise that ALL students can and should access the general curriculum with their non-disabled peers. As an IEP team proceeds through the development of an IEP document, the members identify specific areas of need, goals and objectives and identify programs and services required for the student.
The IEP team makes two separate determinations: what the student should be learning and where a child should learn. The intersection of those two determinations is that particular student’s least restrictive environment (LRE). Depending upon a particular student’s individual needs, examples of least restrictive environments include, but are not limited to: a regular education curriculum in the general education classroom, with or without supplementary aids and services; a modified curriculum for some or all subjects in a regular education classroom; individually designed instruction with the general curriculum in a special education setting for a portion of the day with the remainder of the day being spent in the regular classroom or in activities with students who do not have disabilities; or modified, replacement or alternate curriculum a special education classroom. Thus, one student’s least restrictive environment may be very different from another student’s.

It is the responsibility of the IEP team to determine the extent to which an individual student with a disability will access the general curriculum, with or without modifications and accommodations, or needs to use an alternate/replacement curriculum in whole or in part. In making this decision, IEP teams must consider all of the modifications, accommodations, interventions and/or individually designed instruction that has been implemented and the degree of success of implementation along with the resulting outcomes for the student. All decisions regarding individual students with disabilities begin with the assumption that a student can be successful in the general curriculum.

If a student is not successful in the core curriculum without accommodations and/or modifications or individually designed instruction, then IEP teams must meet to determine what supports need to be in place to help this student to be successful. Those supports may come in the form of accommodations, modifications or additional individually designed instruction. The goal is to have as many students with special education needs as possible be successful in their grade level regular education curriculum and be instructed with their nondisabled peers.

Each school is required to have a Least Restrictive Environment (LRE) goal with an accompanying plan. This plan may include co-teaching/team teaching, programming needs, etc. The LRE goal for the District is to increase the number of students with special education needs that are included in a “push in” model (services provided in the regular education setting) rather than a “pull out” one (services provided in a special education setting) to meet the State goal.

The only students that are not required to work toward their grade level CCSS are those that an IEP team has determined require an alternate curriculum based on Wisconsin Extended Grade Band Standards. Consideration for this includes but is not limited to, the following:

- If the IEP team determines that the student needs are so significant that participation in the WKCE may not be appropriate, they complete the “Wisconsin Alternate Assessment Participation Checklist” (I-7A). The Wisconsin Alternate
Assessment is based on Extended Grade Band Standards, which guides future instruction.

- Once the IEP team has determined that an alternate curriculum based on Wisconsin Extended Grade Band Standards is required, the IEP teacher develops individual student profiles to plan instruction accordingly. A student who is being instructed using Wisconsin Extended Grade Band Standards must use those standards for all subjects. Consideration must still be given as to where services will be provided for each academic subject as it relates to the students IEP needs.

As students make progress, IEP teams note progress and make decisions about moving towards increasing participation in the general curriculum in a less restrictive manner. Success and high outcomes for the student is always the goal.

The principal/educational leader in each school is responsible to make sure all students, including students with disabilities, have access to the appropriate curriculum and appropriate curriculum materials based on their learning needs. The Milwaukee Board of School Directors has recently amplified this requirement in its revision of MPS Administrative Policy and Procedure 7.26 Textbook Adoption and Administrative Policy and Procedure 7.27 Maintenance and Control of Instructional Materials. Central guidance and support regarding these requirements is provided by the Department of Educational Services and the Department of Specialized Services. The Office of Leadership Support and Accountability holds school leaders accountable for this requirement. Each school has developed a School Improvement Plan (SIP) using appropriate student data to determine areas of instructional focus for the school. The Regional Support Model provides ongoing support to ensure that the school is following their School Improvement Plan (SIP) and implementing any other district directives relative to student achievement.

The Milwaukee Public Schools has adopted the Model Policies and Procedures that have been developed by the Wisconsin Department of Public Instruction to ensure compliance with state and federal laws regarding students identified with special education needs. These policies and procedures include fundamental adherence to the individualized nature of all educational decisions for each student with a disability in the least restrictive environment.

The Milwaukee Public Schools has worked collaboratively with the Wisconsin Department of Public Instruction to update its “IEP Policies and Procedures Handbook” which sets forth specific directions to all district staff for the planning and decision making regarding students with disabilities. The “Special Education Oversight Action Plan” (SOAP) includes the establishment of accountability and of the “Regional Systems of Support” that ensures adherence to state and federal laws and high quality outcomes for all students with disabilities. It is the responsibility every school principal/educational leader to implement high quality programs that ensure success for each individual student. Central support and accountability monitoring is provided by the Office of Leadership Support and Accountability, the Department of Specialized Services, the
Department of Curriculum & Instruction and the Department of District Improvement and Support.

Gifted and Talented Programming

Gifted and talented students attend schools across the district. Gifted and talented services begin with strong differentiation in every classroom. Three best practices for differentiating for high-end learning are:

- Flexible Grouping: [http://www.cde.state.co.us/gt/download/word/LighthouseProject_Pago sa_DifferentiationTip2.doc](http://www.cde.state.co.us/gt/download/word/LighthouseProject_Pago sa_DifferentiationTip2.doc)

MPS has four specialty programs for gifted and talented programming, housed at Allen-Field, Golda Meir, Morse-Marshall and Victory schools. To refer students for these programs or for more information, see [http://www2.milwaukee.k12.wi.us/gt/chart.pdf](http://www2.milwaukee.k12.wi.us/gt/chart.pdf).

Early admission to K5 and 1st grade: Per state statute, students may be granted early admission to K5 and 1st grade under certain circumstances. For more information, see [http://www2.milwaukee.k12.wi.us/gt/earlyadmissionsk51.pdf](http://www2.milwaukee.k12.wi.us/gt/earlyadmissionsk51.pdf).

Options for high school students:

- Advanced Placement courses are offered in 20 MPS schools, but are available to any high school student in any school through an online option. There is also an option for testing without completing the AP course. AP exams may qualify for college credit. Call (414) 777-7813 for more information.
- Honors courses are available at some high schools. Contact your school's guidance department.
- The International Baccalaureate Diploma Programme is a rigorous option available to for 11th and 12th graders at King, Reagan and Montessori IB high schools. IB exams may qualify for college credit. Contact the schools for more information.
- Enrollment in colleges and universities through the Youth Options program is another option that is available to high school students across the district. See [http://mpsportal.milwaukee.k12.wi.us/portal/server.pt/doc/66377/10-11+YOP+Application+Procedures.doc](http://mpsportal.milwaukee.k12.wi.us/portal/server.pt/doc/66377/10-11+YOP+Application+Procedures.doc)

Supporting Emotional Needs of Gifted Youth (SENG): SENG is an organization "dedicated to fostering environments in which gifted adults and children, in all their diversity, understand and accept themselves and are understood, valued, nurtured and supported by their families, schools, workplaces and communities." MPS is currently
recruiting volunteers who are interested in pursuing endorsement as trained SENG facilitators. Call 777-7813 for more information. http://www.sengifted.org

A continuum of services: Renzulli and Reis (1997) recommend the development of a continuum of services to challenge the diverse learning and affective needs of gifted and high-potential students. This continuum provides services that range from general enrichment across all grade levels to curriculum differentiation opportunities for both enrichment and acceleration, to advanced classes and individualized research, as well as counseling and other services to meet affective needs. For a graphic representation of Renzulli’s Integrated Continuum of Specialized Services, see http://www.gifted.uconn.edu/sem/images/icss.jpg.

Summer School Services
Milwaukee Public Schools believe that the commitment to effective learning is vital to a student’s growth throughout the year and does not stop for the summer. We offer a multifaceted summer program providing a broad spectrum of opportunities in enrichment and developmental academics for students from grades Kindergarten through 12th grade.

The summer school curriculum in the elementary program includes a three-hour summer block for literacy, science and mathematics. Lessons teach literacy skills through the content area of science in a 90-minute block format. These lessons incorporated the use of authentic literature along with non-fiction read and think alouds, hands-on science experiments and demonstrations leveled science readers and Discovery Streaming Education. The math curriculum aligned to the three textbook series addresses the targeted strands of number operations, measurement and statistics and probability. Formative assessments are embedded throughout the curriculum as well as math vocabulary words that are to be developed with each lesson. To further address the areas of weaknesses identified, alignment to Common Core and/or State Standards are provided for each lesson.

Supplemental Educational Services (SES)
Supplemental educational services are additional academic instruction (free tutoring) designed to increase the academic achievement of students in low-performing schools. SES is a component of Title I of the Elementary and Secondary Education Act (ESEA), as reauthorized by the No Child Left Behind (NCLB) Act. SES provides additional academic instruction, specifically in reading, math and science outside of the regular school day to increase the academic achievement of students in low-performing schools.

SES is available to:

- Low-income students (based on the free/reduced lunch standard)
  Students who perform below the proficient level in math, reading or science
  Students who attend a school that has not made adequate yearly progress for two consecutive years or more.
- Priority must be given to the lowest-achieving children whenever funds are insufficient to meet the requests of all eligible children and their parents.
- SES programs are offered by private tutoring companies and in conjunction with the district.

SES serves grades kindergarten to twelfth, including Special Education students and English Language Learners. Students receive this service at no cost to the parent/guardian or school.
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### MATHEMATICS AND SCIENCE GLOSSARY

**Ability**
An educational aim that involves the whole person; is an integration of skills, behaviors, knowledge, values, attitudes, motives or dispositions and self perceptions; is developmental and can be learned; can be assessed; transfers across settings; is continually re-evaluated and re-defined; is important to personal and/or professional situations in life; is appropriate to the mission/aims and educational philosophy of the institution or program *(Alverno College)*.

**Academic Prompt**
A form of assessment between an authentic performance task and a short-answer test or quiz. Academic prompts are open-ended written performance tests *(Wiggins, G. and McTighe, J.)*.

**Academic Rigor**
Academic rigor means teaching students from a curriculum which prepares them to succeed in college and/or the world of work. High standards are set for success, with grade-level content and lessons aligned to meet those high standards. A rigorous curriculum exemplifies a focused, coherent and appropriately challenging set of expectations for every student.*

**Academic Standards**
Standards that specify what students should know and be able to do, what they might be asked to give evidence of standards and how well they must perform. They include content, performance and proficiency standards *(Wisconsin Department of Public Instruction—WI DPI)*.

**Accountability**
The obligation of reporting, explaining, or justifying standards, making them responsible, explicable and answerable *(Reeves, D.)*.

**Active Learning**
Any situation in which students learn by doing rather than by sitting at their desks reading, filling out worksheets, or listening to a teacher. Active learning is based on the premise that if students are active, they will be highly motivated and will thus learn more *(Ravitch, D.)*.

**Active Literacy**
The integration of critical language skills (i.e., listening, speaking, reading and writing) into the daily curriculum in every class *(Jacobs, H. H. and Johnson, A.)*.

**Alignment**
The process of linking content and performance standards to assessment, instruction and learning in classrooms *(Department of Defense—DOD Schools)*.

**Alternate Assessment**
IEP-based (Individual Educational Plan) assessment used in place of the WKCE at grades 4, 8 and 10 for some special needs students *(WI DPI)*. OR
Any type of assessment in which students create a response to a question, as opposed to assessments in which students choose a response from a given list, such as multiple-choice, true/false, or matching. Alternative assessments can include short answer questions, essays, performance assessments, oral presentations, demonstrations, exhibitions and portfolios *(Michigan Curriculum Framework).

**Analytic Scoring**

A scoring procedure in which a student's work is evaluated for a number of selected traits or dimensions, with each dimension receiving a separate score *(WI DPI).

**Assessment**

Ongoing means of monitoring students' work and progress. Results are used to inform teaching decisions *(Fletcher, R. and J. Portalupi).

**Assessment FOR Learning**

Assessments that we conduct throughout teaching and learning to diagnose student needs, plan our next steps in instruction, provide students with feedback they can use to improve the quality of their work and help students see and feel in control of their journey to success. Assessments for learning happen while learning is still underway. On these occasions, the grading function is laid aside. This is not about accountability…this is about getting better *(Stiggins, R.).

**Assessment OF Learning**

Those assessments that happen to make statements of student learning status at a point in time to those outside the classroom, as when making student referrals or making decisions about programs *(Stiggins, R.).

**Assignment**

A particular task or job given to a student for a specific purpose *(Reeves, D.).

**Assistive Technology (AT)**

Any item, piece of equipment, or product system, whether acquired commercially off the shelf, modified, or customized, that is used to increase, maintain, or improve functional capabilities of children with disabilities *(Reed, P. and Lahm, E.).

**Authentic Assessment**

Assessment that both mirrors and measures student performance in “real world” task and situations.

**Backward Design**

A process to designing curriculum by beginning with the end in mind and designing toward that end *(Wiggins, G. and McTighe, J.).

**Benchmark**

The designated points at which a student’s performance can be measured on the way to becoming proficient in a standard.

**Best Practice**

Serious, thoughtful, informed, responsible, state-of-the art teaching *(Zemelman, S., Daniels, H. and Hyde, A.).

**Best Practice in Writing**

Created by MPS educators in collaboration with members of the Milwaukee Writing Project (MWP) at Carroll University, this document identifies eight best practices of writing that should be present in every MPS classroom and school. The eight include: teacher as writing, writing process, six traits of writing, authentic forms, writers’ workshop, writing strategies, writing-reading connection and effective feedback, *(MPS and NWP).
**Big Idea**

In Understanding by Design, the core concepts, principles, theories and processes that should serve as the focal point of curricula, instruction and assessment. Big ideas are important and enduring. Big ideas are transferable beyond the scope of a particular unit *(Wiggins, G. and McTighe, J.)*.

**Bi-Level Analysis**

The examination of student work and performance data on two levels—the subject matter concepts and skills and the requisite language capacity (e.g., linguistic patterns, three types of distinctive vocabulary and editing and revising strategies) *(Jacobs, H. H. and Johnson, A.)*.

**Bi-lingual**

Any use of two languages *(National Association for Bilingual Education)*.

**Bloom’s Taxonomy**

A hierarchical listing of learning levels, from basic to challenging (knowledge, comprehension, application, analysis, synthesis, evaluation) *(Anderson, L. and Krathwohl, D.)*.

**CABS**

(Classroom Assessments Based on Standards) Classroom assessments aligned to the Milwaukee Public Schools’ Learning Targets; these assessments are developed, adopted, or adapted, then administered and assessed with the purpose of providing specific, meaningful and timely feedback designed to improve student performance *(Milwaukee Public Schools)*.

**Checklist**

A written list of performance criteria associated with a particular activity or product on which an observer marks the pupil’s performance on each criterion using a scale using a scale that has only two choices *(Airasian, P.W.)*.

**Classroom-Based Assessment**

Ongoing assessment by the teacher of student learning during the course of instruction in the school *(WI DPI)*.

**Cluster**

In mathematics, Clusters summarize groups of related standards. Note that standards from different clusters may sometimes be closely related, because mathematics is a connected subject.

**Cognitive Demand**

The type of cognition required of the student defined in Bloom’s Taxonomy of the Cognitive Domain; reflects a classification of thinking rather than a sequential hierarchy *(Washington State)*.

**Collaborative Learning**

An active, group-centered approach to problem solving, task completion and learning. Collaborative learning is based on the idea that learning is a naturally social act in which the participants talk among themselves; it is through the talk that learning occurs *(Adapted from Gerlach, J.)*.

**Common Assessments**

Summative Assessments designed to be used by teachers who teach the same subject; usually chapter, unit or semester tests/exams; used to assess student knowledge, understanding and skill development aligned to the national and state standards.

**Common Core Literacy Standards**

Common Core Literacy Standards set requirements for English Language Arts (ELA) and for literacy in history/social studies, science and technical subjects. Students must learn to read, write, speak, listen and use language effectively in a variety of content areas and the Standards specify the literacy skills and understandings required for college and career readiness.
| Common Core State Standards | The National Common Core State Standards are currently completed for English Language Arts and Mathematics. The criteria used to develop these college-and career-readiness standards (K-12) are: these research-based standards will be aligned with college and work expectations; include rigorous content and application of knowledge through higher-order skills; built upon strengths and lessons of current state standards; informed by top performing countries so that all students are prepared for success in our global economy and society. Specific research and evidence based literacy skills and understandings required for college and career readiness in history, social studies, science and English Language Arts *(Council of Chief State School Officers and the National Governors Association Center for Best Practices; www.corestandards.org).* |
| Community Collaboration | Process by which both mathematics and science incorporate real-world and community resources into the curriculum and include community members and organizations into the development process of teaching and learning in mathematics and learning. |
| Comprehension | The reconstruction of the intended meaning of a communication; accurately understanding what is written or said *(Harris, L. & Hodges, R.)*. |
| Comprehensive Literacy Framework | A conceptual framework utilized for the development of instructional design that integrates reading, writing, listening, speaking, language, technology and research across all content areas to promote critical thinking and learning *(Milwaukee Public Schools).* |
| Concept | An abstract idea that points to a larger set of understandings, (e.g., peace, democracy, culture, power, nationalism, imperialism, war, etc.) *(Reeves, D.)*. |
| Conceptual Framework | Broad description of the content and sequencing for student learning and skill development; scope and nature of the education in science and engineering needed in the 21st century. |
| Conference | A discussion that focuses on setting goals, solving problems and/or monitoring progress *(Tompkins, G.)*. |
| Consensus Map | (Also called a Core Map) Agreed-upon curriculum identified by teachers and administrators that determines which elements must be consistently taught by all teachers in a course or subject and where flexibility will be critical *(Jacobs, H. H. and Johnson, A.)*. |
| Constructed Response | Test items on which students must provide an answer (short answer, explanation of the process for determining the answer, etc.) in contrast with items (known as selected response or multiple-choice) on which students choose from among answers provided. *(ASCD).* |
| Content | Information or essential meaning students need to know in a given standard or component of a standard in a course of study *(Reeves, D.)*. |
| Content Standards | Statements that define what students should know and be able to do in various subject areas and at different points in their education. |
| Context | Circumstances in which a particular event occurs; background information or structure to help make sense of new information *(Reeves, D.)*. |
Cooperative Learning
Classroom activities in which students work together to achieve their individual learning goals *(WI DPI).

Core, Supplement, Intensive
The three tiers of Response to Intervention (RtI) initiative that identify struggling students quickly, promote effective classroom instruction, provide interventions and increase the likelihood that students will be successful *(Mellard and Johnson in Tompkins, G.).

Core Idea in Science
Scientific idea or practice that has broad implications, provides key tools for understanding and investigating complex ideas and solving problems; relates to interests and experiences of students; teachable and learnable over multiple grade levels.

Criteria
A collection of qualitative descriptors of what is expected in a performance *(Alverno College).

Criterion-Referenced Grading
Determining the quality of a pupil’s performance by comparing it to pre-established standards of mastery *(Airasian, P.W.).

Critical Literacy
Using literacy not only to communicate but as a means of understanding and expressing the power relationships undergirding communication; using literacy to participate in and influence the power structure of one’s world *(WI DPI).

Critical Thinking
The thought processes characteristic of creativity, criticism and logic in literature, the arts, science and other disciplines; the analytic or scientific approach to knowledge; the thought processes of analysis and commentary on literature and other arts *(WI DPI).

Cross Cutting Elements
Major ideas that have application across all domains of science – scientific concepts, engineering, technology and society

Cross Discipline Elements
Patterns, similarity, diversity, cause, effect, scale, proportion, quantity, systems and system models, energy, matter, form and function, stability and change.

Curriculum
The skills, performances, attitudes and values pupils are expected to learn from schooling; includes statements of desired pupil outcomes, descriptions of materials and the planned sequence that will be used to teach pupils *(Airasian, P.W.).

Curriculum Map
A systemic process that can improve student performance by sharpening the alignment of all aspects of the curriculum to reduce repetitions and gaps and strengthen the articulation of skills *(Jacobs, H. H. and Johnson, A.).

Data Driven Student Outcomes
Data driven student outcomes, which assist educators to make sense of the student data at their school/district, systematically informs teaching and learning practices and tailors instruction to the needs of each student. Educators make instructional changes aimed at prioritizing instructional time; targeting individual instruction; identifying individual students’ strengths and instructional interventions; gauging instructional effectiveness, refining instructional methods and examining school wide data to consider whether and how to adapt the curriculum based on information about student strengths and weakness.
Deep Understanding

The comprehension of what is taught in a meaningful way. Deep understanding is the goal of instruction; it is the opposite of superficial understanding, which often comes from studying materials for a unit test and then forgetting it as soon as the test is over. Deep understanding means that the student remembers what he or she learned long after the course is concluded, although it is difficult to assess this outcome *(Ravitch, D.).

Diary Map

A map where data are entered on an ongoing basis. Periodically, whether every few weeks or trimester, you will stop and reflect on your work with learners and make an entry *(Jacobs, H. H. and Johnson, A.).

Differentiated Instruction

Procedures for assisting students in learning, providing options, challenging students and matching resources to students to maximize their learning *(Tompkins, G.).

Differentiated Professional Development

Modified professional development based on the level of understanding of the learners *(Jacobs, H. H. and Johnson, A.).

Differentiation

Attending to the learning needs of a particular student or small group of students rather than the more typical pattern of teaching the class as though all individuals in it were basically the same. The goal of a differentiated classroom is maximum student growth and individual success *(Tomlinson, C.).

Differentiated Content, Process and Product

The three elements of an instructional design to ensure that all student needs are met. Teachers need to differentiate the content that is taught; how the content is taught (process); and how the content is assessed (product).

Directions

A set of instructions that tells students what to do to complete a specific task.

Discovery Education

An educational video library that is a digital video-based learning resource used to enhance lessons and projects *(Discovery Education).

Disposition

(Learning) targets that reflect attitudes and feeling states, such as “I like to write.” They represent important affective goals we hold for students as a byproduct of their educational experience and as such, are not assessed for the purposes of grading *(Stiggins, R.).

District Map

In curriculum mapping, the recommended curriculum--often written in the form of standards and benchmarks. District maps include content, skills and assessments *(Adapted from Hayes Jacobs, H.).

Domain

In mathematics, domains are larger groups of related standards. Standards from different domains may sometimes be closely related.

DPI

(Wisconsin) Department of Public Instruction.

Enduring Understanding

Specific inferences, important ideas, or core processes that are central to a discipline and transferable to new situations which have lasting value beyond the classroom *(Wiggins, G. and McTighe, J.).
Engagement

Student engagement has two dimensions, one in the context of the classroom and any given lesson and a second in terms of a student's individual personal commitment to his/her own learning. Engagement in the classroom is manifested by student(s) attending to the task at hand during the lesson. Individual engagement is manifested by students asking (more than routine) questions during the lesson, by their doing individual project work or homework with interest and understanding. ([http://www.lasw.or definitions.html](http://www.lasw.org/definitions.html)).

Engaging Context

The context of mathematics and science teaching which is ‘in-the-making’, shifting from what to why and how (Duschl, 2011). Through such engaging activities as hand-on instructional activities, problem-based projects and experiential learning, students become knowledgeable about the why and how of mathematical and scientific concepts.

Engaging Scenario

The “hook” in a performance assessment designed to attract and hold student interest that sets the context for the set of tasks *(Reeves, D.).

Engineering

Engineering is the creative application of scientific principles to design or develop structures, machines, apparatus and/or manufacturing processes. These designs and structures can be used singly or in combination. Engineers need to determine just how these structures and processes will operate under specific conditions and what will be their intended function as well as the costs of operation and their safety to life and property. ([American Engineers’ Council for Professional Development](http://www.aecp.org/)).

Engineering Design

Approach used by engineers to solve engineering problems for a particular purpose or goal.

Entry Question

A simple, thought-provoking question that opens a lesson or unit. It often introduces a key idea or understanding in an accessible way. Effective entry questions spur discussion about a common experience, provocative issue, or perplexing problems, as a lead-in to the unit and essential questions *(Wiggins, G. and McTighe, J.)*.

Equity

Eliciting and embracing diversity as means of enhancing learning about science and the natural world with rigorous standards for all students.

ESL (consistent usage)

English as a Second Language

ELL

English Language Learner

ESS

Earth and Space Science.

Essential Question

A question that lies at the heart of a subject or a curriculum (as opposed to being either trivial or leading) and promotes inquiry and uncovering of a subject. Essential questions thus do not yield a single straightforward answer (as a leading question does) but produce different plausible responses, about which thoughtful and knowledgeable people may disagree *(Wiggins, G. and McTighe, J.)*.

ET

Engineering and Technology

Evaluation

Making judgments about the quality of student achievement over a period of time, primarily for the purpose of communicating about student achievement *(O’Connor, K.).*
<table>
<thead>
<tr>
<th>Exemplar</th>
<th>Typical or representative; worthy of being imitated; term used to represent proficient student work <em>(Adapted from Reeves, D).</em></th>
</tr>
</thead>
<tbody>
<tr>
<td>Exhibitions</td>
<td>Demanding projects designed and conducted by high school seniors in schools that are members of the Coalition of Essential Schools. Theodore Sizer, founder of the coalition, proposed the notion of exhibitions in his book Horace's Compromise. Noting that students in 19th century New England secondary schools were expected to present evidence of their learning as a requirement for graduation, he suggested that a similar procedure could make modern high school education more meaningful <em>(ASCD).</em></td>
</tr>
<tr>
<td>Experiential Learning</td>
<td>Experiential learning is learning by doing and using the process of reflection to make meaning from these direct experiences. &quot;For the things we have to learn before we can do them, we learn by doing them&quot; (Aristotle as cited in Dewey). The learner is actively involved in the experience; able to reflect on the experience; able to possess and use analytical skills to conceptualize the experience; and is able to possess decision making and problem solving skills in order to use the new ideas gained from the experience.</td>
</tr>
<tr>
<td>Explicit Instruction</td>
<td>Systematic instruction of concepts, strategies and skills that build from the simple to the complex *(Tompkins, 2010) The teacher names the strategy, tells how to use the strategy, models using the strategy, provides examples of when to use the strategy and when to make adjustments to the strategy for different tasks and indicates the usefulness of the strategy. From the National Math Panel (2008), “teachers provide clear models for solving a problem type using an array of examples, that students receive extensive practice in use of newly learned strategies and skills, that students are provided with opportunities to think aloud (i.e., talk through the decisions they make and the steps they take) and that students are provided with extensive feedback.”</td>
</tr>
<tr>
<td>Externality</td>
<td>Achievement of distance from classroom learning experiences by various degrees <em>(Alverno College).</em></td>
</tr>
<tr>
<td>Facet of Understanding</td>
<td>A way in which a person’s understanding manifests itself. Understanding by Design identifies six kinds of understanding: self-knowledge, empathy, application, perspective, interpretation and explanation <em>(Wiggins, G. and McTighe, J.)</em>.</td>
</tr>
</tbody>
</table>
Feedback

Information provided by a teacher, peer, or other on a person’s performance in relationship to criteria, with the purpose of improving future performance *(Alverno College)

Types of feedback: *(Adapted from Stiggins, R. and Brookhart, S.)

- **Descriptive Feedback** Feedback that recognizes ongoing progress and focuses on what needs improvement
- **Motivational Feedback** Feedback designed to encourage and support the learner; does not include specific steps for improvement
- **Evaluative Feedback** Feedback that conveys a judgment without any explanation that gives guidance for improvement; a summary of student achievement at a point in time
- **Effective Feedback** Feedback that is specific enough that the learner can use it to feed forward to the next performance; effective feedback includes not only lists—it explains why and provides strategies or guidance regarding what might be done differently to improve.

Feedforward

To employ effective feedback to improve the teaching and learning process; feedback is not valuable until the learner uses it to improve the next performance and the teacher uses it to guide future instructional decisions *(Adapted from Davies, A.).

Formative Assessment

Assessment for the purpose of learning.

Framework for Effective Teaching

Four domains for the assessment of teacher ability in the classroom: Planning and Preparation, the Classroom Environment, Instruction and Professional Responsibilities integrated with the MPS school improvement process: Plan, Do, Study, Act. *(Danielson, 2009).

GE Foundation Developing Futures in Education

General Electric (GE) Foundation program created to raise student achievement through improved math and science curricula and management capacity in school districts.

Grade Bands

Division of science progressions of learning by grade bands: K- cx2; 3-5; 6-8; 9-12.

Graphic Organizer

Diagrams that provide organized visual representations of information *(Tompkins, G.).

GRASPS

In Understanding by Design, GRASPS are performance tasks found in Stage II. GRASPS is an acronym that stands for Goal, Role, Audience, Situation, Performance or Product and Standards for Success. They are meant to be authentic, engaging experiences aligned to Stage I. *(Identified Learning Goals) *(Adapted from G. Wiggins and J. McTighe).

Guided Practice

The part of a mini-lesson in which students continue to use a strategy with teacher guidance, but without modeling *(Cooper, J.D.).

Holistic Scoring

In writing assessment, assigning a single general-impression score to writing samples based on the overall presentation and content rather than on an accumulation of points. Holistic scoring is criterion-referenced, using rubrics and a set of anchor papers selected from the entire population sample to represent the range of performance levels in the rubric *(WI DPI).
Inquiry

Inquiry is an instructional approach, which is a multifaceted, active learning strategy that helps students to develop critical reasoning and problem solving skills, confront new ideas, deepen their understandings and think logically and critically. Engaging in inquiry requires the simultaneous coordination of knowledge and skills, inquiry goes beyond engagement of students in the classroom to the real world with experimentation or hands-on activities.

Integrated Curriculum

A curricular organization intended to bring into close relationship the concepts, skills and values of separately taught subjects to make them mutually reinforcing *(Harris, T. and Hodges, R.).

Interdisciplinary

Involving the integration or joining together of two or more branches of learning, i.e., history and English; science and art; math, music and physical education, etc. *(Reeves, D.).

Interest Inventory

A series of statements to which students respond orally or in writing; meant to reveal a student’s interests and or/attitudes *(Cooper, J.D.).

Inter-Rater Reliability

A term used to describe the relationship of the scores (ratings) between and among two or more judges (raters). This can be computed in a variety of ways from simple correlations to percentage of agreement. The larger numbers indicate a greater degree of agreement *(Reeves, D.).

Intervention

The systematic and explicit instruction provided to accelerate growth in an area of identified need. They are designed to improve performance relative to a specific, measurable goal. Interventions are based on valid information about current performance, realistic implementation and include ongoing student progress monitoring.

Tier 2 (targeted) interventions are to be implemented when assessment indicates that a student is not making adequate gains from universal instruction alone. They are generally smaller group interventions designed to meet the specific needs of a student and his/her peers with similar needs.

Tier 3 (Intensity) interventions are those which offer a student highly individualized, systematic and explicit instruction in an area of assessed need. Although the programs or strategies may be similar to those offered at Tier 2 interventions, the intervention is reclassified as “intensive” if it is individualized to meet the needs of a particular student and the duration and/or intensity of the intervention is increased to accelerate student response.

Investigations

Mathematics and Science investigations are classroom, laboratory or field experiences that provide students with opportunities to interact directly with natural phenomena or with data using tools, materials, data collection techniques and models. Students are given opportunities to design their own investigations (i.e. Science Fairs), engage in scientific reasoning, manipulate equipment, record data, analyze results and discuss their findings. Investigations are an important part of the inquiry process. (NRC, 2006).

Journals

Places where students record personal reflections *(Adapted from Cooper, J.D.).
Learning Centers: Spaces in the classroom filled with materials for independent student activity focusing on current topics of study within content areas and including literacy materials as well *(Morrow, L.M.).

Learning Logs: Daily records of what a student has learned; does not include a response; logs can be focused on a particular area of learning *(Cooper, J.D.).

Learning Progressions: Essential component ideas and principles necessary to understand a core idea in science; extending over multiple years; anchored on one end by what students know and how they reason when they enter school and at the other end, by expectations about what all students need to understand about science by the end of high school.

Learning Targets: Standards-based, grade-specific statements of what students should know and be able to do in various content areas *(Milwaukee Public Schools).

Learning Team: A team comprised of individuals at the school community who are selected and prepared to collect and interpret data to inform the school’s educational plan, provide support to teachers, enable professional development embedded at the school site for all school personnel and help create positive conditions in the school context for teachers’ and students’ learning *(Milwaukee Public Schools).

Learning Team Continuum in Mathematics: In order to understand standards-based teaching and learning, MPS Mathematics has created a learning tool to inform each school’s learning team and teachers of mathematics about the process of unpacking Common Core State Standards, using formative/summative assessments and connecting these elements to studying samples of student work, providing insights into data-driven student outcomes.

LESA: Instructional design in mathematics, which includes the process of teaching with Launch, Explore, Summarize, Apply and Assess.

LS: Code for Next Generation Life Science

Mathematically Literate: K-12 mathematics students will be mathematically literate, i.e. able to read, write, speak and listen for understanding of mathematical concepts, processes and skills.

Mathematical Processes: Mathematically processes are the NCTM standards of problem solving, reasoning and proof, communication, representation and connections. (NCTM).

Mathematics Standards: The mathematics standards identify strands of mathematical proficiency to include adaptive reasoning, strategic competence, conceptual understanding (comprehension of mathematical concepts, operations and relations), procedural fluency (skill in carrying out procedures flexibly, accurately, efficiently and appropriately) and productive disposition (habitual inclination to see mathematics as sensible, useful and worthwhile, coupled with a belief in diligence and one’s own efficacy. (NRC: Adding it Up!).
Metacognition

The ability to be conscious of and, to some degree, exercise control over one’s own thinking. Educators have come to use the prefix “meta” to refer to the application of a process to the process itself. (For example, meta-analysis is analysis of a large number of research studies on a particular topic.) In this case, cognition is thinking, so metacognition means thinking about one’s own thinking. You are using metacognition when you can track your progress is solving a multi-step problem or when you realize that you have been looking at a page in a book without following the meaning and backtrack until you find the place where your mind began to wander *(ASCD).*

Mini-lesson

A short, focused lesson, often at the beginning of the workshop [writing block] designed to address an issue or relevant to the community of writers in the classroom *(Fletcher, R. and Portalupi, J.)*

Misconceptions

Misconceptions are often help by students, especially in mathematics and science, based on incorrect or inaccurate prior knowledge that they bring to the classroom. Oftentimes, they are formed in inaccurate information previously gathered or improper use of logic in the development of an argument. For the teacher, it is important that he/she recognizes that students come to classroom with these misconceptions and work with the students to ensure that they understand the importance of correcting their misconceptions.

MPS Adopted Textbook

Official textbook or resources adopted by the Milwaukee Board of School Directors per Administrative Policy and Procedure 7.26.

Model

An assessment model using a variety of assessment methods and processes to determine student progress toward reaching predetermined outcomes *(Stiggins, R.)*

Modifications

Modifications alter content knowledge expectations, as well as, assessment administration practices.

Multiple Measures

Assessment that measures student performance in a variety of ways. Multiple measures may include standardized tests, teacher observations, classroom performance assessments and portfolios *(WI DPI).*

National Common Core Mathematics Standards

The approved national mathematics standards for K-12 schools, incorporating the Wisconsin State Standards in mathematics. The standards include both process and content standards for which students should be assessed for proficiency.

NCTM

National Council of Teacher of Mathematics

Needs Assessment

A broad-based appraisal of objectives and conditions in a particular situation as they interrelate; an attempt to relate goals to existing strengths, weaknesses and feasible changes *(Harris, T. and Hodges, R.)*

Non-negotiables

The core elements that must be taught in the curriculum *(Jacobs, H. H. and Johnson, A.)*

Observation

Looking at student performance of literacy tasks in order to note achievement and draw inferences on which to base instruction *(Cooper, J.D.)*

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<thead>
<tr>
<th>On-Demand Assessment</th>
<th>Measurement of learning, the timing of which is determined by the teacher, administrator, district, or state rather than as an ongoing component of the instructional process *(WI DPI).</th>
</tr>
</thead>
<tbody>
<tr>
<td>Open-Ended Question</td>
<td>Question or task with no single “right” answer. Allows responses from multiple perspectives, understandings and experiences *(Reeves, D.).</td>
</tr>
<tr>
<td>Outcome</td>
<td>Describes what a student will be able to do with what she knows in personal, professional and/or academic contexts as a result of a set of learning experiences *(Alverno College).</td>
</tr>
<tr>
<td>Pedagogy</td>
<td>The art, science, or profession of teaching; instructional strategies and activities *(WI DPI).</td>
</tr>
<tr>
<td>Peer Conference</td>
<td>Conference between two students having to do with reading or writing *(Cooper, J.D.).</td>
</tr>
<tr>
<td>Performance-Based Assessment</td>
<td>Direct, systematic observation of an actual student performance or examples of student performances and rating of that performance according to pre-established performance criteria *(Adapted from Weins, M.).</td>
</tr>
<tr>
<td>Performance Expectations</td>
<td>Statements that describe activities and outcomes which students can be expected to achieve as a means to demonstrate their ability to understand and apply the knowledge described in the content statements. What we expect students to know, understand and do; demonstrate knowledge; engage in mathematics and science practices to develop a better understanding of the essential knowledge; support targeted instruction and assessments by providing tasks that are measureable and observable.</td>
</tr>
<tr>
<td>Performance Standards</td>
<td>Explicit definitions and concrete examples of how well students are expected to learn the material represented by content standards.</td>
</tr>
<tr>
<td>Performance Task</td>
<td>An authentic, meaningful task that requires students to synthesize knowledge and skills learned and apply them to construct a response, create a product and/or performance that demonstrates understanding *(DOD Schools).</td>
</tr>
<tr>
<td>Planning</td>
<td>Another term for “selecting the topic;” this is the first step in process writing; during this step students decide what they want to write about *(Cooper, J.D.).</td>
</tr>
<tr>
<td>Portfolio</td>
<td>A well-defined, purposeful collection of pupil products or performances that shows pupil achievement of particular skills over time *(Adapted from Airasian, P.W.).</td>
</tr>
<tr>
<td>Preconceptions</td>
<td>Concepts that students have developed in their prior exposure to mathematical and scientific concepts.</td>
</tr>
<tr>
<td>Prerequisite Knowledge and Skill</td>
<td>The knowledge and skill required to successfully perform a culminating performance task or achieve a targeted understanding *(Wiggins, G. and McTighe, J.).</td>
</tr>
<tr>
<td>Product</td>
<td>The tangible and stable result of a performance and the processes that led to it *(Wiggins, G. and McTighe, J.).</td>
</tr>
<tr>
<td><strong>Professional Development Management System</strong></td>
<td>The MPS staff login service, which allows teachers and other staff to receive and accept professional development activities offered by MPS. Through <strong>ENROLL</strong> MPS staff can enroll in a specific session and the district can therefore track the number of participants in a particular session as well as which sessions had adequate or above participation rates.</td>
</tr>
<tr>
<td><strong>Professional Learning Community (PLC)</strong></td>
<td>A group or organization that strives to embody the following characteristics; a shared mission, vision and values; collective inquiry; collaborative teams; action orientation and experimentation; continuous improvement; and results orientation <em>(Adapted from DuFour, R. and Eaker, R.)</em>.</td>
</tr>
<tr>
<td><strong>Proficiency Standards</strong></td>
<td>Standards that describe the quality of student work in relation to a content standard (i.e. minimal, basic, proficient or advanced) <em>(CESA #1)</em>.</td>
</tr>
<tr>
<td><strong>Proficiency-Based Learning</strong></td>
<td>A learning model in which student achievement is measured in relation to specific standards and outcomes <em>(CESA #1)</em>.</td>
</tr>
<tr>
<td><strong>Project Based Learning</strong></td>
<td>Project Based Learning, or PBL, is the use of in-depth and rigorous classroom projects to facilitate learning and assess student competence. Students use technology and inquiry to respond to a complex issue, problem or challenge. PBL focuses on student-centered inquiry and group learning with the teacher acting as a facilitator.</td>
</tr>
<tr>
<td><strong>Projected Map</strong></td>
<td>A map that has been created prior to teaching a course or subject and then revised on an ongoing basis as the school year progresses <em>(Jacobs, H. H. and Johnson, A.)</em>.</td>
</tr>
<tr>
<td><strong>Prompt</strong></td>
<td>An assignment that directs students to generate a particular kind of writing (usually Expository, Narrative, Expository and/or Persuasive) <em>(Fletcher, R. and Portalupi, J.)</em>.</td>
</tr>
<tr>
<td><strong>PS Code for New Generation Physical Science standards.</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Reflection</strong></td>
<td>The process of thinking about one’s practice and experiences, whether by internal musing, dialogue, or expressive writing, as in a journal <em>(WI DPI)</em>.</td>
</tr>
<tr>
<td><strong>Reliability</strong></td>
<td>The extent to which an assessment consistently assesses whatever it is assessing; if an assessment is reliable, it will yield the same or nearly the same information on reassessment <em>(Airasian, P.W.)</em>.</td>
</tr>
<tr>
<td><strong>Reciprocal Teaching</strong></td>
<td>An activity in which the teacher and students take turns modeling the use of strategies <em>(Tomkins, G.)</em>.</td>
</tr>
<tr>
<td><strong>Resultant Knowledge and Skill</strong></td>
<td>Knowledge and skill that are meant to result from a unit of study. In addition to the targeted understanding, teachers identify other desired outcomes (for example, “skill in listening”) <em>(Wiggins, G. and McTighe, J.)</em>.</td>
</tr>
<tr>
<td><strong>RTI</strong></td>
<td>Response to Intervention; the three tiers of Response to Intervention (RtI) initiative that identify struggling students quickly, promote effective classroom instruction, provide interventions and increase the likelihood that students will be successful <em>(Mellard &amp; Johnson in Tompkins, G.)</em>.</td>
</tr>
<tr>
<td><strong>Rubric</strong></td>
<td>An established set of criteria for scoring or rating students’ performance on tests, portfolios, writing samples, or other performance tasks.</td>
</tr>
</tbody>
</table>
Scaffolding: Instructional strategy used to offer students a system of support (e.g., a vocabulary list of definitions, a visual example showing how to design a word web, the use of both visual and verbal directions, etc.) for achieving competence in the learning task *(Reeves, D.)*.

SCANS Report (Secretary's Commission on Achieving Necessary Skills): A report issued in 1991 by the Department of Labor identifying the knowledge, skills and abilities that future workers would need to succeed in entry-level jobs. Competencies listed in the SCANS report included basic skills (reading, writing, mathematics, listening and speaking), thinking skills (creative thinking, decision making, problem solving, visualizing symbols, reasoning and knowing how to learn) and personal qualities (responsibility, self-esteem, sociability, self-management and integrity). The SCANS 2000 Center at Johns Hopkins University continues to promote the teaching of these skills in elementary, middle and secondary schools *(ASCD)*.

School Improvement Plan (SIP): Each school in MPS has a School Improvement Plan including literacy, mathematics and climate goals and targets. The plans are updated monthly and commonly are based on data-driven student outcomes to promote change when and where needed.

Science 7Es: The instructional design for science teaching, which includes: Elicit, Engage, Explore, Explain, Elaborate, Evaluate, Extend and Summarize.

Scientific Literacy: Students ability to read, write, speak and listen for understanding of the scientific concepts, skills and processes necessary to become a 21st skilled individual in our global economy.

Scientific Method: Process of theory development and testing which is iterative; using deductive and inductive logic; incorporates many tools including experimentation, modeling, scenario building and examination of one’s own work.

Scientific Practices: Practices of scientists as they engage in the investigations and build models and theories about the natural world; engaging in scientific inquiry using knowledge and skills simultaneously.

Selected Response: Preferred by some testing specialists over the more common term "multiple choice" because it is more specific and contrasts with "constructed response," meaning items that require the student to provide an answer *(ASCD)*.

Self-Assessment: The process of doing a systematic review of one’s own performance, usually for the purpose of improving future performance.

SEN/EEN/SWD: SEN = Special Education Needs/ EEN = Exceptional Education Needs/ SWD = Student With a Disability.

Six Trait Writing: A research-based writing model assessing student performance in six main components (traits) of writing. Through the use of the Six Trait Model, teachers are able to assess specific strengths and weaknesses in students’ writing and plan instruction. Students are provided effective feedback allowing them to improve their writing by using purposeful revision and editing strategies. The six components of the model are: ideas, organization, voice, word choice, sentence fluency and variety and conventions *(Adapted from Spandel, V.)*.
<table>
<thead>
<tr>
<th>Sizing-up Assessments</th>
<th>Assessments used by teachers in the first weeks of school to get to know pupils so that they can be organized into a classroom society with rules, communication and control *(Airasian, P.W.).</th>
</tr>
</thead>
<tbody>
<tr>
<td>Small Group Instruction</td>
<td>Students are organized in small groups based upon instructional goals rather than only on placement along a continuum of text levels. Participation in small group is flexible and determined by level of student need. *(Adapted from Honig, Diamond, &amp; Gultohn).</td>
</tr>
<tr>
<td>Small Group Work Stations</td>
<td>Areas within the classroom where students interact with one another using instructional materials to explore and expand their literacy. These are places where a variety of activities reinforce and/or extend learning from whole group mini-lessons, often without the direct assistance of the classroom teacher. Time spent in small group (literacy) work stations is time for students to practice reading, writing, speaking, listening and working with other language arts skills *(Adapted from Diller, D.).</td>
</tr>
<tr>
<td>Specifications for Learning Targets</td>
<td>Detailed information that describes what students are expected to know and do to achieve a Learning Target including the range of concepts, ideas and skills; the size or quantity of number, words and elements; specification are the “teachable components” of the Learning Targets *(MPS).</td>
</tr>
<tr>
<td>Standard</td>
<td>Defines the level of skill students must demonstrate on the learning outcome.</td>
</tr>
<tr>
<td>Standardized Tests</td>
<td>Assessments that are administered and assessed in exactly the same ways for all students. Traditional standardized tests are typically mass-produced and machine-assessed and are designed to measure skills and knowledge that are thought to be taught to all students in a fairly standardized way. Performance assessments can also be standardized if they are administered and assessed in the same way for all students. Standardization is an important consideration if comparisons are to be made between scores of different individuals or groups *(Michigan Curriculum Framework).</td>
</tr>
<tr>
<td>Standards Achievement Report (SAR)</td>
<td>One type of scoring guide designed to replace the traditional report card, consisting of the rubric (e.g., for English Language Arts, “read and recognize literature as an expression of human experience”), a description of the Performance Standard (e.g., 4=exemplary, 3=proficient, 2=progressing, 1= not meeting the standards), teacher and parent comments and a plan for meeting the standard *(Reeves, D.).</td>
</tr>
<tr>
<td>Strands of Scientific Proficiency</td>
<td>Knowing, using, interpreting scientific explanations of the natural world; generating and evaluating science evidence and explanations; understanding the nature and development of scientific knowledge and participating productively in scientific practices and discourse.</td>
</tr>
<tr>
<td>Strategy</td>
<td>A practiced but flexible way of responding to recognizable contexts, situations, or demands. Because no single study technique or writing process is best for all students, effective teachers design tasks to help every student to acquire a range of strategies and to learn how to choose and apply those that best fit their needs and the literacy situation at hand *(WI DPI).</td>
</tr>
</tbody>
</table>
**STEM**

Science, Technology, Engineering and Mathematics. These do not exist in isolation from society. Each has its own histories and cultural roles. The environmental impacts of human actions on both local and global scales are pressing current societal issues. Scientists and engineers are part of societies and their approaches, attitudes and values generally reflect those of the society in which they live. Science and engineering professions have internal ethics and responsibilities. Students who see themselves as science oriented and science capable are more likely to feel confident to consider scientific inputs as important to their personal decision-making. Mathematics is a central and integral feature of science and engineering.

**Student Performance Expectations in Science**

Science students will be assessed through a wide variety of formative and summative assessments and experiential learning opportunities. A proficient student uses causal, ontological, epistemological, technological and communicative questions; engages in argument and critique; initiates the development of hypotheses; formulates questions that can be empirically investigated; constructs models and prototype designs; collects, analyzes and interprets data; and communicates and interprets scientific and technical knowledge.

**Studying Samples of Student Work**

Working within a collaborative group, teachers look at student work which is presented by a teacher(s) who describe the instructional context (standards) for the student work, a description of the student work so that other teachers can ask probing question, provide feedback on the work and reflect on the results of using this sample of student work. Student work can be an artifact, a student’s performance and records of a student’s performance and behaviors. As teachers collaborate, they are able to talk about they do and why they do it so that become a reflective practitioner.

**Study Techniques**

Techniques taught to students to help them study, think about and remember information; common techniques are underlining, note taking, outlining and using mapping or graphic organizers *(Cooper, J.D.)*.

**Summative Evaluation**

The final evaluation, usually quantitative in practice, of the degree to which the goals and objectives of a program have been attained *(Harris, T. and Hodges, R.)*.

**Teacher Self-Assessment**

The process of making decisions about one’s own teaching performance based on evidence and reflection *(Airasian, P.W.)*.

**Test**

A formal, systemic procedure for obtaining a sample of pupils' behavior; the results of a test are used to make generalizations about how pupils would perform on similar but untested behaviors *(Airasian, P.W.)*.

**Theme**

The major focus of a unit that crosses curricular areas; usually a concept or understanding and may involve more than one topic *(J.D. Cooper)*.

**Theory of Action**

A Theory of Action states that change is a continuous cyclical process of plan, do, study, act Knowledge, best practices, instruction, leadership, continuous improvement, data driven student outcomes provide the theory of action for the CMSP.
Think Aloud  A kind of explicit modeling in which the teacher shares his or her own thinking processes when performing a task *(J.D. Cooper).

Tiered Assignments  According to Tomlinson (1995), tiered assignments are used by teachers within a heterogeneous classroom in order to meet the diverse needs of the students within the class. Teachers implement varied levels of activities to ensure that students explore ideas at a level that builds on their prior knowledge and prompts continued growth. Student groups use varied approaches to explore essential ideas.

Tiered Products  Tiered products and varied levels of choices of activities used as chapter or unit tests, projects, written responses to ensure that students are assessed at their current level of understanding and skill development.

Tiered System of Professional Development  According to the MPS Professional Development Plan, a tiered system of professional development will be implemented: universal support (Tier 1 (Core Content) schools), strategic support (Tier 2 interventions schools) and intensive support (Tier 3 interventions schools).

Touchstone Text  Touchstone texts are one of three primary forms of mentor texts that grade-level or common-course teachers agree to use during whole group instruction, so that every student is “touched” by the experience. Teachers in each grade level or course make local decisions based on their students’ needs. By the end of a student’s K-12 education he or she will harvest a healthy array of mentor texts that contribute to his or her textual lineage *(Adapted from Tatum, A.).

Trade Book  A published book that is not a textbook; the types of books in bookstores and libraries *(Tompkins, G.).

Transferability  The ability to use knowledge appropriately and fruitfully in a new or different context from that in which it was initially learned *(Wiggins, G. and McTighe, J.).

Transitions  Movement, passage, or change from one position, state, stage, subject, concept, etc., to another; change.

21st Century Skills  21st century skills are those skills assure the readiness of every student to be able to compete in a global economy that demands innovation, fusing reading, writing and mathematics with critical thinking and problem solving, communication, collaboration and creating and innovation skills. The Partnership for 21st Skills works with local, state and federal governments to adapt policies that support his approach for every school *(http://p21.org/).

Uncoverage  A teaching approach that is required for all matters of understanding. To “uncover” a subject is to do the opposite of “covering” it, namely to go into depth *(Wiggins, G. and McTighe, J.).

Understanding  An insight into ideas, people, situations and processes manifested in various appropriate performances. To understand is to be able to make sense of what one knows, to be able to know why it’s so and to have the ability to use it in various situations and contexts *(Wiggins, G. and McTighe, J.).
| **Universal Screener** | The assessment used by MPS called MAP (Measure of Academic Progress), using assessments K-12 in reading and mathematics. The screener is used by schools and teachers to inform instruction. |
| **Validity** | A reflection of the intended measure. Validity means that we are assessing what we think we are assessing *(Adapted from Reeves, D.)*. |
| **Whole Group Instruction** | A time within the instructional block when the teacher is instructing the entire class on content and skills based on grade-level expectations. Whole group instruction (also called mini-lessons) is a short amount of time. The teacher follows up with differentiated small group guidance designed to provide students the scaffolded support needed to meet the expectations of the on-level work *(MPS)*. |
| **Wisconsin State Teacher Standards** | Set of ten (10) Teacher Standards that are used to determine a teacher’s knowledge, skill and disposition for and of teaching *(WI DPI)*. |
| **WKCE-CRT** | Wisconsin Knowledge and Concepts Examination Criterion-Referenced Test *(WI DPI)*. |
| **Workplace Literacy** | Literacy that “focuses attention on individuals in relation to the societal and economic concerns of a nation” *(Newman & Beverstock in Harris, T. and Hodges, R.)*. |
| **Writing to Learn** | The use of writing to “facilitate learning with text by helping students to explore, clarify and think deeply about ideas and concepts encountered when reading: *(Vacca and Vacca, 1993)*. Note: In this view of writing, the relationship between writing and reading is intimate and interactive. |
| **WSAS** | Wisconsin Student Assessment System *(WI DPI)*. |
| **Zone of Proximal Development** | The distance between a child’s actual development level as determined through independent problem solving and (his or her) potential development (level) as determined through problem solving under adult guidance or a collaboration with more capable peers *(Vygotsky, L. in Harris, T. and Hodges, R.)*. |
NATIONAL STAFF DEVELOPMENT COUNCIL STANDARDS

As Milwaukee Public Schools creates a structure and focus for district wide staff development, it is necessary for all staffs to understand the basic underlining principles for high quality staff development. The National Staff Development Council's Standards for staff development recognize that sustained, rigorous staff development is essential for everyone who affects learning. Staff development is the means by which staff acquires and enhances the knowledge, skills, attitudes and beliefs necessary to create high levels of learning for all students. The National Staff Development Council’s (NSDC) Standards recognizes that sustained, rigorous staff development is essential for everyone integral to the learning process. These standards are a landmark contribution in raising the performance levels of students.

I. LEARNING COMMUNITIES
Staff development that improves the learning of all students organizes adults into learning communities whose goals are aligned with those of the school and district.

II. LEADERSHIP
Staff development that improves the learning of all students requires skillful school and district leaders who guide continuous instructional improvement.

III. RESOURCES
Staff development that improves the learning of all students requires resources to support adult learning and collaboration.

IV. DATA-DRIVEN
Staff development that improves the learning of all students uses disaggregated student data to determine adult learning priorities, monitor progress and help sustain continuous improvement.

V. EVALUATION
Staff development that improves the learning of all students uses multiple sources of information to guide improvement and demonstrate its impact.

VI. RESEARCH-BASED
Staff development that improves the learning of all students prepares educators to apply research to decision making.

VII. DESIGNS AND STRATEGIES
Staff development that improves the learning of all students uses learning strategies appropriate to the intended goal.
STATE OF WISCONSIN EDUCATOR STANDARDS - TEACHERS
Ten Standards for Teacher Development and Licensure
To receive a license to teach in Wisconsin, an applicant shall complete an approved program and demonstrate proficient performance under all of the following standards:

1. **Teachers know the subjects they are teaching.**
   The teacher understands the central concepts, tools of inquiry and structures of the disciplines she or he teaches and can create learning experiences that make these aspects of subject matter meaningful for pupils.

2. **Teachers know how children grow.**
   The teacher understands how children with broad ranges of ability learn and provides instruction that supports their intellectual, social and personal development.

3. **Teachers understand that children learn differently.**
   The teacher understands how pupils differ in their approaches to learning and the barriers that impede learning and can adapt instruction to meet the diverse needs of pupils, including those with disabilities and exceptionalities.

4. **Teachers know how to teach.**
   The teacher understands and uses a variety of instructional strategies, including the use of technology, to encourage children's development of critical thinking, problem solving and performance skills.

5. **Teachers know how to manage a classroom.**
   The teacher uses an understanding of individual and group motivation and behavior to create a learning environment that encourages positive social interaction, active engagement in learning and self-motivation.

6. **Teachers communicate well.**
   The teacher uses effective verbal and nonverbal communication techniques as well as instructional media and technology to foster active inquiry, collaboration and supportive interaction in the classroom.

7. **Teachers are able to plan different kinds of lessons.**
   The teacher organizes and plans systematic instruction based upon knowledge of subject matter, pupils, the community and curriculum goals.

8. **Teachers know how to test for student progress.**
   The teacher understands and uses formal and informal assessment strategies to evaluate and ensure the continuous intellectual, social and physical development of the pupil.

9. **Teachers are able to evaluate themselves.**
   The teacher is a reflective practitioner who continually evaluates the effects of his or her choices and actions on pupils, parents, professionals in the learning community and others and who actively seeks out opportunities to grow professionally.

10. **Teachers are connected with other teachers and the community.**
    The teacher fosters relationships with school colleagues, parents and agencies in the larger community to support pupil learning and well-being and acts with integrity, fairness and in an ethical manner.
Wisconsin Educator Standards - Administrators

Seven Standards for Administrator Development and Licensure

To receive a license in a school administrator category in Wisconsin, an applicant shall complete an approved program in school administration and demonstrate proficient performance in the knowledge, skills and dispositions under all of the following standards.

a. The administrator has an understanding of and demonstrates competence in the ten Teacher Standards.

b. The administrator leads by facilitating the development, articulation, implementation and stewardship of a vision of learning that is shared by the school community.

c. The administrator manages by advocating, nurturing and sustaining a school culture and instructional program conducive to pupil learning and staff professional growth.

d. The administrator ensures management of the organization, operations, finances and resources for a safe, efficient and effective learning environment.

e. The administrator models collaborating with families and community members, responding to diverse community interests and needs and mobilizing community resources.

f. The administrator acts with integrity, fairness and in an ethical manner.

g. The administrator understands, responds to and interacts with the larger political, social, economic, legal and cultural context that affects schooling.
Wisconsin Educator Standards - Pupil Services
Seven Standards for Pupil Services Development and Licensure

To receive a license in a pupil services category in Wisconsin, an applicant shall complete an approved program and demonstrate proficient performance in the knowledge, skills and dispositions under all of the following standards.

- The pupil services professional understands the ten Teacher Standards.
- The pupil services professional understands the complexities of learning and knowledge of comprehensive, coordinated practice strategies that support pupil learning, health, safety and development.
- The pupil services professional has the ability to use research, research methods and knowledge about issues and trends to improve practice in schools and classrooms.
- The pupil services professional understands and represents professional ethics and social behaviors appropriate for school and community.
- The pupil services professional understands the organization, development, management and content of collaborative and mutually supportive pupil services programs within educational settings.
- The pupil services professional is able to address comprehensively the wide range of social, emotional, behavioral and physical issues and circumstances which may limit pupils' abilities to achieve positive learning outcomes through development, implementation and evaluation of system-wide interventions and strategies.
- The pupil services professional interacts successfully with pupils, parents, professional educators, employers and community support systems such as juvenile justice, public health, human services and adult education.
### Table 6: Current MPS District Adopted Mathematics Textbooks and Instructional Materials

<table>
<thead>
<tr>
<th>Grade Band</th>
<th>Class/Course</th>
<th>Textbooks</th>
<th>Copyright</th>
</tr>
</thead>
<tbody>
<tr>
<td>6-8</td>
<td>Middle Grades</td>
<td>Connected Mathematics 2, Pearson Prentice Hall</td>
<td>2006</td>
</tr>
<tr>
<td>6-8</td>
<td>Middle Grades</td>
<td>Holt Mathematics, Holt, Rinehart, Winston</td>
<td>2007</td>
</tr>
<tr>
<td>9&lt;sup&gt;th&lt;/sup&gt; grade</td>
<td>Algebra</td>
<td><em>Discovering Algebra: An Investigative Approach</em> (Second Edition), Key Curriculum Press</td>
<td>2007</td>
</tr>
<tr>
<td>10&lt;sup&gt;th&lt;/sup&gt; grade</td>
<td>Geometry</td>
<td><em>Discovering Geometry: An Investigative Approach</em> (Fourth Edition), Key Curriculum Press</td>
<td>2008</td>
</tr>
<tr>
<td>11&lt;sup&gt;th&lt;/sup&gt; grade</td>
<td>Algebra II</td>
<td><em>Discovering Advanced Algebra: An Investigative Approach</em> (Second Edition), Key Curriculum Press</td>
<td>2010</td>
</tr>
</tbody>
</table>

Note: MPS expects to adopt new CCSS aligned materials as they become available.
# MPS District Adopted Science Textbooks and Instructional Materials

Table 7: Current MPS District Adopted Science Textbooks and Instructional Materials

<table>
<thead>
<tr>
<th>Grade Band</th>
<th>Class/Course</th>
<th>Textbooks</th>
<th>Copyright</th>
</tr>
</thead>
<tbody>
<tr>
<td>6-8</td>
<td>Middle Grades Science</td>
<td>Holt Science &amp; Technology and Holt Ciencias &amp; Technologia. Holt, Rinehart Winston</td>
<td>2002</td>
</tr>
<tr>
<td>10</td>
<td>Biology</td>
<td>Biology and Biologia, Stephen Nowicki, Holt McDougal</td>
<td>2012</td>
</tr>
<tr>
<td>10-12</td>
<td>Environmental Science</td>
<td>Environmental Science: Holt Environmental Science, Karen Arms, Holt</td>
<td>2008</td>
</tr>
<tr>
<td>11-12</td>
<td>AP Environmental Science</td>
<td>Environmental Science: A Global Concern, Cunningham, McGraw Hill</td>
<td>2011</td>
</tr>
<tr>
<td>10-12</td>
<td>IB Environmental Science</td>
<td>Environmental Systems and Societies Course Companion, IB Diploma Programme, Jill Rutherford, Oxford University Press</td>
<td>2009</td>
</tr>
</tbody>
</table>
Table 8: Adopted Supplemental Science Materials

<table>
<thead>
<tr>
<th>Grade Band</th>
<th>Class/Course</th>
<th>Instructional Material</th>
<th>Copyright</th>
</tr>
</thead>
<tbody>
<tr>
<td>K-5</td>
<td>Elementary Science</td>
<td>Engineering is Elementary, Museum of Science, National Center for Technological Literacy</td>
<td>2005-2008</td>
</tr>
<tr>
<td>K-8</td>
<td>Elementary and Middle Grades</td>
<td>Discovery Education Science, Discovery Communications</td>
<td>2007-2011</td>
</tr>
<tr>
<td>K-8</td>
<td>Elementary and Middle Grades</td>
<td>Great Lakes in My World, Alliance For The Great Lakes</td>
<td>2005</td>
</tr>
<tr>
<td>K-12</td>
<td>Elementary, Middle and High School</td>
<td>Wisconsin K-12 Energy Education Program (KEEP), The Wisconsin Center for Environmental Education</td>
<td>2006</td>
</tr>
</tbody>
</table>