MADISON METROPOLITAN SCHOOL DISTRICT

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Daniel A. Nerad, *Superintendent of Schools*

Date: May 31, 2012

APPENDIX NNN-12-3
June 25, 2012

To: Board of Education

From: Lisa Wachtel, Executive Director of Curriculum & Assessment
Tim Peterson, Assistant Director of Curriculum & Assessment

RE: Science Program Evaluation

Presenters
Lisa Wachtel, Executive Director of Curriculum & Assessment
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Background
The MMSD Science Program Evaluation took place during the 2011-12 school year. The process included assembling an advisory team with diverse background, data collection, data analysis and synthesis, and finally the development of recommendations. This document presents the highlights from this plan.

The Program Evaluation has taken place during a time of significant change. During the process, the Next Generation Science Standards were being developed at the national level, with the State of Wisconsin signaling that these will become our new state standards. This process is similar to the development/adoption of the Common Core State Standards in English/Language Arts and Mathematics. Early indications are that the new standards will have a significant impact on science instruction K-12. Keeping this in mind, the Advisory Committee has attempted to “chart a course” to place the MMSD science program in a position to support student success, close the achievement gap, and provide an excellent foundation for all students’ future educational plans, including both college and career/technical education options.

The Advisory Committee
The advisory committee was composed of teachers of science representing elementary, middle, and all four high schools, ESL/Bilingual/DLI, Cultural Relevance, Professional Development, Research and Evaluation, and Institutes of Higher Education.

The Data
Data was collected on student achievement on standardized tests, teacher instructional practices, value-added information, and state and national data. The committee also looked at the level of community involvement in support of science education in the district.

Student data showed that the district generally is behind the state on WKCE science scores when taken as an aggregate. However when looking at disaggregated data, several unexpected student groups are above the state average for students scoring Proficient + Advanced on the WKCE while others are below. The district mirrors the state and the nation regarding science proficiency in many respects.

Data Analysis and Synthesis
The analysis of the data highlighted 5 key elements: time for science, an unacceptable failure rate, teacher preparation, science in high schools, and the process for implementing the Next Generation Science Standards.

- Time for science: in trying to balance the need to close the achievement gap with regards to Literacy and Mathematics, the committee believes that science provides a context for the use of these two content areas.
- Unacceptable failure rate: too many students are failing at key transition points in their academic careers.
- Teacher professional development: where professional development has occurred, student achievement has improved. There is a lack of professional development for teachers at elementary and high school.
- Science in secondary schools: consistent 9^{th} grade courses, improved communication with guidance, and opportunities for middle school and high school teachers to plan need to be implemented in order to respond to the new standards, focus on student achievement, and connect students to science career pathways.
- Process for implementing the Next Generation Science Standards: the new standards will require significant work in order provide the educational program envisioned by the standards.

Recommendations
The recommendations were categorized similar to the Literacy Program Evaluation from 2010-11. There are seven broad recommendations, each with several specific action steps to support the recommendation. The recommendations are below, as well as 1-2 significant action steps.

1. Consistent, culturally relevant and aligned K-12 curriculum
   a. Scope and Sequence development along with core practices
   b. 9^{th} grade course development
2. Align program with the 8 Scientific and Engineering Practices of the Next Generation Science Standards; increase the use of data within the district program
   a. Increase science credit graduation requirement to 3 credits
   b. Ensure minutes of instruction in science are met
3. Implement science interventions and assessments that support the Response to Intervention and Instruction process within the district
   a. Implement science specific programming options available to all students
   b. Implement interventions and progress monitoring to support science instruction for all students
4. Review and purchase science program materials to achieve consistency and equity district-wide
   a. Identify material that supports implementation of the Next Generation Science Standards
   b. Phased implementation with strong professional development
5. Implement science assessments which provide data to drive program improvement
   a. Implement a comprehensive science assessment system to include common summative assessments
   b. Implement a process to ensure that data helps inform classroom instruction and overall program improvement
6. Work collaboratively to provide a culturally diverse science teaching staff across the district
   a. With HR, work to increase hiring highly effective, culturally aware science teachers
   b. Work to develop building level science expertise through teacher leadership
7. Establish a comprehensive and flexible science professional development plan
   a. Develop and provide strong on-line professional development for every grade level

b. Improve classroom safety through a district-wide safety professional development program

Board Action Requested

The Board is requested to accept the Science Program Evaluation.

APPENDIX NNN-12-3
June 25, 2012

Madison Metropolitan School District
K-12 Science Program Evaluation

Findings and Recommendations for Continual Improvement of Science Education

Submitted to the Madison Metropolitan School District

Board of Education

May 21, 2012

Prepared by the Science Advisory Committee

Science Program Evaluation
Table of Contents

Introduction

During the committee work for this program evaluation, the question was raised several times by several of the committee members: is the district truly committed to improving science education? Will it have the focus to do what is needed to successfully change science education in the district? Is this committee work valued?

The response to these questions was that no one knows the events that will shape the future. What is known is that those people who have a plan of where they are going and are flexible in how they get there, are most often the ones who arrive at their goal. In other words, this document is designed as a map for the journey of science improvement in the Madison Metropolitan School District. What is contained in this document is a vision of where we should be going and one way of getting there.

There are some major goals set forth in this document: improvements in professional development for teachers, improved connections with the community as a whole and the scientific community specifically, a movement towards connections across content areas to support engaged learning for all students and closing the achievement gap by improving ways of knowing what students understand and supporting them when they struggle. There was not a lack of ideas for program improvement!

One thing that was clear was the concept of change. The committee worked with the understanding that the future was uncertain with regards to many things: state and local standards, state testing instruments, and district funding levels were just a few. It was felt that if the committee were to wait for "things to settle down" – in other words, for change to stop – that the group would still be waiting to meet. This document provides the groups "best vision" of where the district should put its efforts in the journey towards <u>all</u> students achieving at the highest levels and doors of opportunity being held wide open.

The future depends on how well we do achieving that vision.

Chapter 1

Program Evaluation:
History and Background

> **"Science and engineering – significant parts of human culture that represent some of the pinnacles of human achievement – are not only major intellectual enterprises but also can improve people's lives in fundamental ways. Although the intrinsic beauty of science and a fascination with how the world works have driven exploration and discovery for centuries, many of the challenges that face humanity now and in the future – related, for example, to the environment, energy, and health – require social, political, and economic solutions that must be informed deeply by knowledge of the underlying science and engineering."**
>
> *A Framework for K-12 Science Education: Practices, Crosscutting Concepts, and Core Ideas*
> National Academy of Sciences, 2012

Purpose of Program Evaluation

Science has been a driving force throughout human history. We are born with a natural curiosity about the world around us; we wonder, question, and investigate those things which we don't understand. Arguably, our society exists due to science and the practical application of reasoning throughout history.

This K-12 Science Program Review, the second such review process by the Madison Metropolitan School District, is occurring during a transition period with regards to the State of Wisconsin and the nation's understanding of what it means to "teach science". During the process of this program review, the National Academy of Sciences published a draft version of A Framework for K-12 Science Education: Practices, Crosscutting Concepts and Core Ideas. This is the first document that provides guidance and explanation for the Next Generation Science Standards, to be released in December 2012. These new "national" science standards are highly likely to be adopted by the State of Wisconsin as a replacement for the Wisconsin Model Academic Standards in Science. The WMAS in Science has recently come under criticism for having no rigor; the Standards have received an "F" grade by a national group. The Wisconsin Knowledge and Concepts Exam (WKCE) is also being replaced in 2015, as the WKCE has been shown to be a less than rigorous exam.

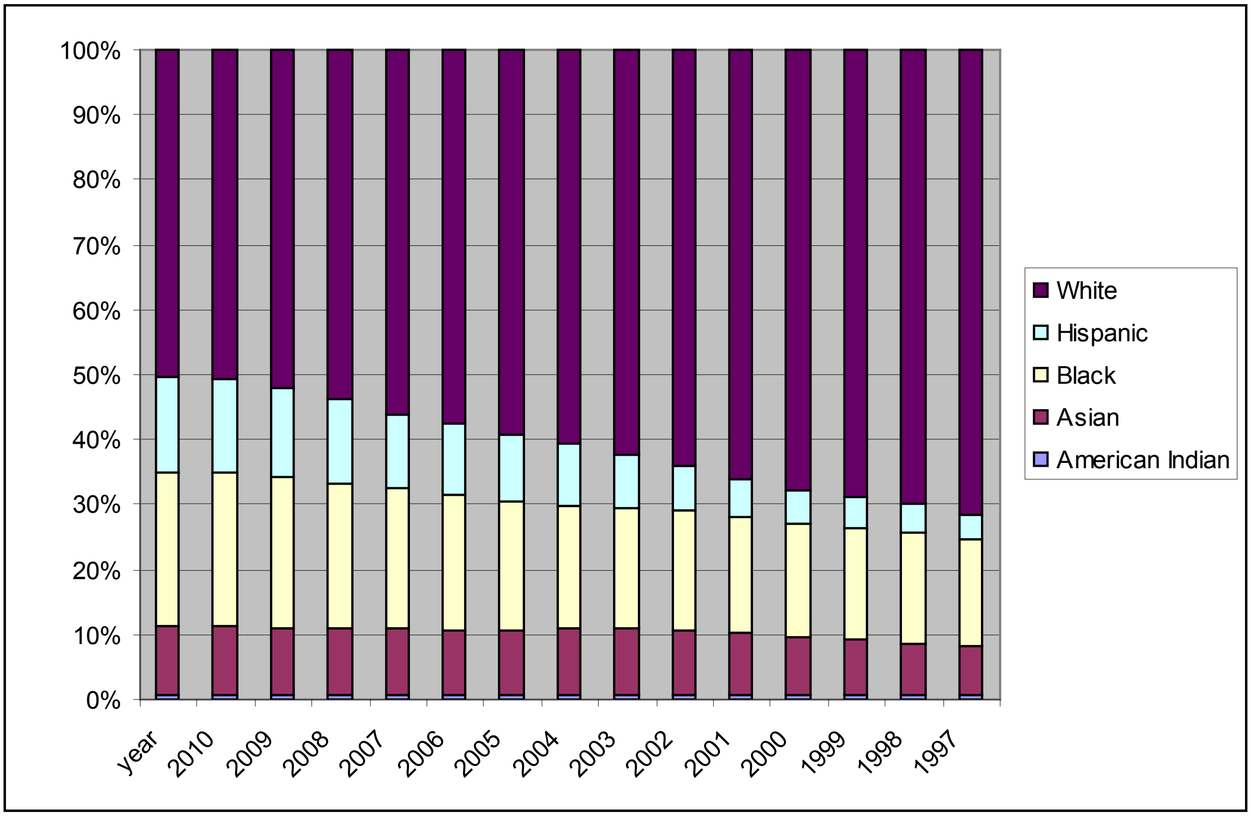
Given the point in time in which this review was written, and with the limited knowledge of the exact nature of the new standards, the committee worked to put MMSD in a position to take full advantage of future programmatic opportunities. The key, as with most successful curricular changes, lies in professional development. While learning materials are very important, strong teachers who are able to work through the changing environment with a deep commitment to student learning and development is critical.

As the district is experiencing tremendous change, our commitment to providing the best science education possible remains sharp and focused.

The demographics in the Madison Metropolitan School District have changed dramatically over the last decade (see chart below). In 2010, the number of students of color reached the 50% mark. In addition to the racial demographics of the district changing rapidly, there has also been an influx of students that are English Language Learners (ELL) from 9% to 18% and an increase in the number of students receiving free or reduced meals from less than 30% to almost 50%.

These dramatic changes speak to the critical and urgent need for the District to fully review its curricular programming to ensure that systems and classroom practices respond to the current and future learning needs of the students. Furthermore, program evaluation requires that after analysis and reflection, programs and practices that are not proven effective must be abandoned or substantially revised so that improved student learning can be clearly demonstrated.

Enrollment in MMSD Over Time



School districts are expected to continuously improve student achievement and ensure the effective use of resources. Evaluation is the means by which school systems determine the degree to which schools, programs, departments, and staff meet their goals as defined by their roles and responsibilities. It involves the collection of data that is then transformed into useful results to inform decisions. In particular, program evaluation is commonly defined as the systematic assessment of the operation and/or outcomes of a program, compared to a set of explicit or implicit standards as a means of contributing to the improvement of the program.

Program evaluation is a process. The first step to evaluating a program is to have a clear understanding of why the evaluation is being conducted in the first place. Focusing the evaluation helps an evaluator identify the most crucial questions and how those questions can be realistically answered given the context of the program and resources available. With a firm understanding of programs and/or activities that might be evaluated, evaluators consider who is affected by the program (stakeholders) and who might receive and or use information resulting from the evaluation (audiences). It is critical that the administration work with the Board of Education on clearly defining the key questions any evaluation is designed to answer to assure that what is produced meets expectations.

Whether the evaluation is being conducted in order to determine success or failure (summative evaluation) of a program, or to make improvements through adjustments based on ongoing feedback (formative evaluation), planning the evaluation includes developing processes to understand the target audience, developing meaningful program objectives, and selecting appropriate indicators to answer questions. An effective evaluation should identify if the program has been implemented as intended and has produced desired outcomes. As prioritizing evaluations can be challenging for a school district with many programs, there are several considerations that may be weighed when determining stakes of programs and their outcomes including:

- **Program cost** – Programs that are expensive need to be proven effective and if not, improved or abandoned.
- **Importance of outcomes** (e.g., implications of program failure) – Certain programs have serious implications for failure.
- **Perceived importance of program/outcomes by stakeholders and audiences** – In some cases the reason a program is being evaluated has to do with a request by an audience (e.g., a funding source).

Board of Education Program Evaluation Approval

The following steps were suggested by the MMSD Board of Education to formalize the MMSD evaluation protocol. The recommendations were informed in large part by the work commissioned to Hanover Research Council (HRC). The HRC study included contacting several K-12 districts across the country to determine current and best practices.

Curricular Program Review Cycle

A key part of the MMSD overall district evaluation strategy includes a regular curricular program review. Curricular areas recommended for review include literacy, math, science, social studies, world languages, the arts, health and physical education, and career and technical education. Each curricular area would rotate through a cycle of review on a seven year basis. The stages of the review include:

- **Year 1** – Evaluation design and preliminary data collection, evaluation committee established and oversight tasks, Evaluation Year/Data interpretation, report and recommendations
- **Years 2/3** – Refinement of evaluation design and data collection based on continuous feedback and oversight, review and select curriculum resources, conduct professional development
- **Year 4** – Program revisions and implementation of curriculum, additional professional development, on-going monitoring
- **Year 5** – Additional professional development and on-going monitoring
- **Year 6** – Continued professional development, preparation for year 1 program evaluation cycle tasks

Program Evaluation	2010-2011	2011-2012	2012-2013	2013-2014	2014-2015	2015-2016
Year 1	Literacy	Science	World Languages	Social Studies	Career & Technical	Physical Education & Health
Year 2		Literacy	Science	World Languages	Social Studies	Career & Technical
Year 3			Literacy	Science	World Languages	Social Studies
Year 4				Literacy	Science	World Languages
Year 5					Literacy	Science
Year 6						Literacy
Program Evaluation	**2016-2017**	**2017-2018**	**2018-2019**	**2019-2020**	**2020-2021**	**2021-2022**
	Mathematics	Fine Arts	Literacy	Science	World Languages	Social Studies

Science Program Evaluation Approval

The second program MMSD approved for review in 2011-2012 was science. When "science" is discussed within this program review, it was defined in the most traditional sense of the content area. This document refers to connections with other areas: literacy, mathematics, career and technical education to name a few. Areas for continued discussion include the role of environmental education, the growing education for sustainability movement, and the role that large district resources will play in the future (e.g. the Planetarium, the School Forest).

> **"By the end of 12th grade, students should have gained sufficient knowledge of the practices, crosscutting concepts, and core ideas of science and engineering to engage in public discussions on science-related issues, to be critical consumers of scientific information related to their everyday lives, and to continue to learn about science throughout their lives. They should come to appreciate that science and the current scientific understanding of the world are the result of many hundreds of years of creative human endeavor. It is especially important to note that the above goals are for all students, not just those who pursue careers in science, engineering, or technology or those who continue on to higher education."**
>
> *A Framework for K-12 Science Education: Practices, Crosscutting Concepts, and Core Ideas*
> National Academy of Sciences, 2012

Further, effective program evaluating also requires an understanding of the elements of successful reading programs, including:

- Good leadership and organization;
- Parental and community involvement;
- Effective intervention strategies;
- Adequate time allotted to science;
- Assessments based on multiple measures; and
- Thorough professional development.

The essential first step to a science program evaluation is to clearly define the research objectives and questions which decision makers consider most important for the study to address. The questions below have served as a guide to the Advisory Committee's work.

- What does the current K-12 MMSD science program look like?
- What is the current K-12 MMSD science intervention practice/system?
- What are the science achievement scores? How has the science program improved student learning in regard to science achievement scores?
- How extensively and consistently do teachers use best instructional practices in science?
- How can the District best use professional development and other means to extend the use of best practices across all schools and classrooms?
- To what degree do professional development initiatives support enhanced student achievement and/or use of instructional best practices?
- What do principals and teachers consider the highest priorities of the District in support of science practices within schools and classrooms?
- What specific interventions have improved significantly student science achievement performance? How much have they improved achievement?
- Is science achievement performance uniformly improved by certain science interventions or does it vary by specific subgroups of students? If not uniform, what factors, including specific instructional practices, affect this?
- Is student science achievement performance improved consistently across all schools and classrooms or does improvement occur inconsistently across schools and classrooms? IF not uniform, what factors, including specific instructional practices, affect this?
- How much do we spend on our science program efforts annually? In what areas are expenses incurred?
- How cost-effective are the current science interventions used in terms of student science achievement scores?
- Are there differences in the effectiveness/cost-effectiveness of specific science interventions?
- What factors contribute to the some interventions being more or less effective/cost-effective?
- To what degree do supplementary science programs enhance student achievement?

It is important to note that program evaluation is most intensive in year 1, but is a multi-year cyclical process. The work of the Science Program Review Committee is detailed in the following chapters of this report. The processes and tools used to clarify these essential questions are summarized in addition to illuminating areas requiring further study and evaluation throughout the full six-year cycle of program review.

Chapter 2

Science Program Evaluation Process

> **"All young children have the intellectual capability to learn science. Even when they enter school, young children have rich knowledge of the natural world, demonstrate causal reasoning, and are able to discriminate between reliable and unreliable sources of knowledge. In other words, children come to school with the cognitive capacity to engage in serious ways with the enterprise of science.**
>
> **This finding leads to a sobering insight: as educators, we are underestimating what young children are capable of as students of science—the bar is almost always set too low. Moreover, the current organization of science curriculum and instruction does not provide the kind of support for science learning that results in deep understanding of scientific ideas and an ability to engage meaningfully in the practices of science. In sum, science education as currently structured does not leverage the knowledge and capabilities students bring to the classroom. For students from diverse backgrounds, this problem is even more profound."**
>
> *Taking Science to School*
> Duschl, Schweingruber, and Shouse
> National Research Council, 2007

Purpose

The Madison Metropolitan School District is committed to implementing a process of continual improvement. At the most critical core of its mission, the District must ensure all students are literate in multiple content areas and prepared for college or to enter careers of their choosing upon graduation. Toward this end, the Science Program Evaluation Advisory Committee was established. The purpose of the Science Program Evaluation Advisory Committee is to consult and advise toward the development and refinement of an articulated continuum of curricula, assessment and science-based interventions as directed by the Board of Education and as described in the Science Program Evaluation documents.

Charge Statement

At the December 14, 2009 Board of Education meeting, the following motion was passed:

> *"Direct the administration to evaluate district reading programs, which could include development of additional interventions for students below proficiency in elementary schools."*

The process to carry out this directive was approved on February 8, 2010. The literacy program is the first content area to be reviewed under the MMSD Program Evaluation and Curriculum Review Process.

Science Program Evaluation Advisory Committee

The science advisory committee included broad pre K-12 district-wide representation. The purpose of the science advisory committee was to research, develop and refine an articulated continuum of curricula, assessment and science interventions. Membership included: the Executive Director of Curriculum & Assessment; Chief Information Officer; Assistant Director for Equity and Family Involvement; Assistant Director of Curriculum & Assessment; Research and Evaluation staff; Professional Development Staff; Middle School Principal; Elementary School Principal; Career and Technical Education Coordinator; ESL Program Support Teacher; Special Education; Science Instructional Resource Teachers; Talented and

Gifted Education; elementary, middle and high school science teacher leaders; Elementary REACH teacher; higher education representation from UW- Madison (Education Outreach and Partnerships; Department of Curriculum & Instruction) and from Edgewood College. (See Appendix A for Science Advisory Committee Membership.)

Protocol

The Science Advisory Committee and any established subcommittee(s) were advisory. The work of the Science Program Evaluation Advisory Committee and any subcommittee(s) took place during scheduled meetings.

Role

The role of the Science Advisory Committee included:

- Attendance at Science Advisory Committee meetings
- Active participation during Science Advisory Committee meetings

The role of Science Advisory Committee members also included:

- Projects and/or work as defined by the District to support the specified goal of the subcommittee

Beliefs about Science and Science Education

As the committee began its work, the first action was to create a common point of reference. These statements were designed to align directly with the District Mission Statement. The group, through an iterative process, developed a mission and belief statements around science education in the Madison Metropolitan School District. Below is this consensus mission and belief statements.

Science Mission Statement

The mission of science education in the Madison Metropolitan School District is to develop scientifically literate students who will have the skills to apply the principles of science in making decisions and solving complex problems.

Given this, we believe that...

TEACHING AND LEARNING

- Every student has the right to a science education built on scientific and engineering practices and crosscutting concepts that unify the study of these through their common applications across fields, is systematic across multiple years, and provides engaging and relevant opportunities to experience how science is actually done
- The focus of science curriculum must be on improving the learning of ALL students.
- Every student deserves highly competent and qualified science teachers.
- Every student should have the opportunity to learn in a safe environment with appropriate and sufficient materials.
- Student learning increases when curriculum and pedagogical alignment is accomplished through the use of rigorous and challenging content and skill standards, high quality assessments, and effective teaching practices.
- All stakeholders should be involved in enhancing science education through partnerships.

INSTRUCTIONAL STRATEGIES

- Science instruction should be inquiry-based, student-centered, collaborative, engaging, and culturally relevant.
- Instruction should be focused on the strategies that support students constructing their own knowledge.

- Instruction around scientific literacy and literacy in science should be explicit and embedded within the curriculum.
- Instruction should include connections between science, technology, engineering, and mathematics (STEM) and other curricular areas, be differentiated, and provide students with varied course options leading to multiple career choices.
- Science learning is a developmental progression and instruction should support children in building upon and revising their knowledge and abilities over time.
- Technology tools can improve science instruction and increase student learning, and should be available and accessible.
- Science education should provide opportunities, experiences, and understandings, within the school day, for students to become active and informed citizens.
- Assessment should guide instruction, content development, and teaching practice, and provide a summary of student understanding.

PROFESSIONAL DEVELOPMENT

- Time is a necessary resource for teachers to study and apply current research in science, learning theory, and instructional practice.
- Professional development that is ongoing, systematic, and data driven is critical to improved science education.
- Professional development should be differentiated and modeled on desired instructional practices (inquiry-based, student-centered, collaborative, engaging, and culturally relevant).

These belief statements helped to guide the committee through its work. The committee believes that these statements will help drive the improvement of science education for all students in Madison schools.

Meetings and Communication

The Science Advisory Committee met for half-day meetings, beginning in October. Half-day meetings were scheduled monthly from October through February. To assure completion of the work, one day long meeting was also held in. Agendas were sent out to the full committee prior to meetings. All meetings were publicly noticed and open to the public. (See Appendix B for meeting schedules and agendas.)

Timeline

The Science Advisory Committee worked under a mutually agreed upon timeline to complete the overall charge. (See Appendix C for the Science Evaluation Timeline.)

Chapter 3

Why Learn Science?

> **"Science is important for another, often overlooked reason. To the degree that we actually know science, we have knowledge and strategies with which to examine evidence systematically, interpret, and control our surroundings. Knowledge of science can enable us to think critically and frame productive questions. Without scientific knowledge, we are wholly dependent on others as 'experts.' With scientific knowledge, we are empowered to become participants rather than merely observers. Science, in this sense, is more than a means for getting ahead in the world of work. It is a resource for becoming a critical and engaged citizen in a democracy."**
>
> *Ready, Set, SCIENCE!*
> Michaels, Shouse, and Schweingruber
> National Research Council, 2008

A Natural Curiosity

By their very nature, children are curious and want to know how the world works. Children naturally like to explore, build and invent. Research indicates that science educators should utilize this curiosity and build and expand upon their scientific knowledge. (Taking Science to School, 2007) Children can be engaged over time as they observe objects, design investigations, collect data, and discuss and argue their ideas. For some children, their interest and success in science class could engage them in school overall.

Developmental Stages of Connection to Science

There is an incorrect but common view of children as hopelessly concrete and unable to think abstractly. We know through experience that they have deep knowledge of natural phenomena. They are able to reason in ways that can provide the foundation for scientific thinking. They enter school with an impressive set of knowledge skills that assist them in working with new knowledge in sophisticated ways. They do not necessarily realize what makes science so unique.

Very young children are found to be tracking a wide range of properties of the world around them. They also come to link them to very broad ideas about how things work, processes, matter, the living world, and the universe. Many times they have misunderstandings, but they aren't wrong about everything. They have successfully learned about patterns, cycles, and regularities in ways that help them interpret and explain their world. They are able to predict and anticipate what will happen next.

Children are also able to engage in reasoning that can be used as beginning points for generating and gathering evidence to explain their thinking. Their ability to distinguish cause and effect is an important foundation for designing experiments. They have the ability to consider ideas and beliefs that are separate from the material world. These skills should be used as points of departure for science education. Children are ready to engage in instruction that incorporates relatively complex scientific practices from the very start of their schooling.

Importance of Science to Society

Science can be looked at as an enterprise that can be harnessed to improve quality of life on a global scale. Whether it's creating treatments for diseases, technologies for dispersing clean water, or computer models that help track the impact of the human footprint on the environment, these issues and many others will always require attention now and in the future. Scientific productivity requires a workforce of not only scientists, but of policy makers, journalists, and a broader network of people who make critical contributions to science and the scientific endeavor. It is critical that we teach science to all children because it is a critical factor in maintaining and improving the quality of life. Through science individuals gain knowledge and strategies to think critically, examine evidence systematically, interpret, and question productively. Scientific knowledge empowers citizens to become participants instead of observers. Both science and science education are regular topics of conversation and are found in the spotlight of media attention on a regular basis. After all, where would humankind be without scientific knowledge and application of that knowledge over time.

Science Drives Modern Society

Scientists have used the discovery of DNA to help map the human genome, can prevent diseases that used to kill thousands of people, and have landed probes on Mars. Science has paved a way for doing things today that weren't even dreamt about 100 years ago; with the digital age, particle physics and many other areas of emerging science, imagine what the next 100 could bring. Major public policy issues, like climate change, require a scientifically informed citizenry as never before.

Basic Research

International networks of scientists pursue basic questions about the natural world and build powerful technologies to improve health and standards of living. The United States and other nations are scrambling to figure out how to feed and support the scientific enterprise. As described in the seminal report Science for All Americans released in 1989:

> Education has no higher purpose than preparing people to lead personally fulfilling and responsible lives. For its part, science education—meaning education in science, mathematics, and technology—should help students to develop the understandings and habits of mind they need to become compassionate human beings able to think for themselves and to face life head on. It should equip them also to participate thoughtfully with fellow citizens in building and protecting a society that is open, decent, and vital. America's future—its ability to create a truly just society, to sustain its economic vitality, and to remain secure in a world torn by hostilities—depends more than ever on the character and quality of the education that the nation provides for all of its children.
>
> There is more at stake, however, than individual self-fulfillment and the immediate national interest of the United States. The most serious problems that humans now face are global: unchecked population growth in many parts of the world, acid rain, the shrinking of tropical rain forests and other great sources of species diversity, the pollution of the environment, disease, social strife, the extreme inequities in the distribution of the earth's wealth, the huge investment of human intellect and scarce resources in preparing for and conducting war, the ominous shadow of nuclear holocaust—the list is long, and it is alarming.
>
> What the future holds in store for individual human beings, the nation, and the world depends largely on the wisdom with which humans use science and technology. And that, in turn, depends on the character, distribution, and effectiveness of the education that people receive.
>
> The link between science education and the successful future in an increasingly technological society has been pointed out by nearly every report since Science for All Americans.

Health, Wellness, Communication, etc.

The world is changing much faster now than it was just a couple of decades ago. Countries with scientifically proficient workers are likely to fare much better than those without them. Good decisions on issues like stem cell research, climate change, and energy policy require that people have a solid science education.

To comprehend the implications of science literacy let us use the concept of an ecosystem. People should know about the delicate balance that exists in any ecosystem, which humans tamper with through their use of natural resources and waste disposal. Humans currently engage in over fishing, but perhaps they would be less likely to do so if those who engage in the act knew that dramatically reducing or wiping out a population of fish does more than just harm that species. It also puts in danger the organisms that depend on that species of fish for survival and gives an advantage to their prey, initiating a chain reaction of consequences for all the organisms in the ecosystem produced because the initial species' prey and predators also interact with other living things in it. While perhaps obvious to those who are science inclined, this simplification of the effects of over-fishing serves to exemplify how people could become smarter in their actions with even a moderate level of scientific literacy.

The idea of scientific literacy is especially important with regards to health. Consider, the effective education campaigns conducted to combat malaria. This has helped people make the connection between high levels of mosquitoes and the presence of stagnant water, which serves as their breeding grounds and should be drained to reduce mosquito numbers. Similarly, knowing that infection causing bacteria largely depend on a moist environment for survival can help people truly seize the importance of avoiding touching mucous openings (like the eyes, nose and mouth) with unwashed hands and increase the chance of people acting appropriately when sick. As these examples suggest, the possibilities for improved health are endless with increased scientific literacy, especially in the area of preventive medicine. If people have a better idea of how the body systems function and what causes infections (for example, what's the difference between a virus and bacteria?), they have the tools to avoid behavior that will damage or put at risk their health. Improved literacy has been correlated to enhanced health (which, admittedly is perhaps in part a reflection of other underlying disadvantages of people with little education), but imagine what increased *science* literacy could do for improved health around the world in both highly developed and underdeveloped nations [Global Health Forum].

Connecting with Careers of the Future

Recent research can help teachers and other educators meet the many demands being made on them. This research points toward a kind of science education that differs greatly from what occurs in many, if not most, science classrooms today.

In a report entitled "Pathways to Prosperity: Meeting the Challenge of Preparing Young Americans for the 21st Century," researchers at the Harvard Graduate School of Education call for a national movement to support millions of young Americans on a realistic path to either employment or college. In many high schools around the nation, students choose courses based on mandatory requirements for graduation which lead to college or workforce involvement. While these courses may be rigorous and well taught, the system in which these courses exist can lack clear career-based pathways and options for students, integration of work and academic learning, or extensive employer involvement with standard curricula.

Career Pathways

What they are

In order to change our students' hope for the future and provide support from 9th grade through 12th grade, MMSD is working to design and implement informed Career Pathways to bridge what students learn during their high school years with what they will do after they graduate, creating a seamless transition from high school to postsecondary to career. These pathways will be individualized for students' future plans to prepare all students for success at their next educational level and beyond.

As an example of one pathway of this new design, students whose future plans include being a physical therapist, nurse, doctor, lab technician, or EMT will take courses and participate in real-life work experiences that relate to the health field. Adding a segment of work-based learning can also be used as a powerful tool for engaging students. Interested students will explore a variety of work-based options, including volunteer opportunities, job shadows, mentorships, job fairs, paid internships, and the Youth Apprenticeship Program. When they arrive at college or enter a career, students will already have relevant knowledge and practical experience working in their chosen field.

The district is making a commitment to work with our staff and community in providing an engaging high school experience to prepare our youth for a hopeful future and ensure an engaging high school experience. The supports for students within these new pathways will provide more connections for students to decrease the dropout rate and assure all students are prepared to graduate on-time and are prepared for postsecondary choices in life.

Connecting with problem solutions of the future

The field of engineering will be a new addition to what happens in K-12 science classrooms upon implementation of the Next Generation Science Standards. Given this new direction and the lack of connections in a typical science classroom, this section provides a starting point for building bridges between traditional science education and engineering as it may become part of K-12 science education.

On February 15, 2008, the National Academy of Engineering announced its list of 14 "grand challenges for engineering," examples of the types of challenges confronting societies in the twenty-first century. The solutions to these challenges will all have large engineering components. Although engineers cannot solve these challenges alone, neither can the challenges be solved without engineers.

The Grand Challenges for Engineering may be a framework for developing K-12 lessons and activities that support the Next Generation Science Standards and the engineering strand present there. As curricular material is developed, units created, and teaching practices changed to reflect the NGSS plan, these challenges may provide an excellent framework for thinking.

Grand Challenges for Engineering

The fourteen grand challenges are:

1. Making solar power economical;
2. Providing energy from fusion;
3. Developing carbon-sequestration methods;
4. Managing the nitrogen cycle;
5. Providing access to clean water;
6. Restoring and improving urban infrastructure;
7. Advancing health informatics;
8. Engineering better medicines;
9. Reverse-engineering the brain;
10. Preventing nuclear terror:
11. Securing cyberspace;
12. Enhancing virtual reality;
13. Advancing personalized learning; and
14. Engineering the tools of scientific discovery.

More information regarding the Grand Challenges for Engineering can be found at the National Academy of Engineering web site: http://www.engineeringchallenges.org/. While much work will need to be done to make these concepts attainable and useful for teachers of science, much of the work has been started by the work of the National Academy of Engineering.

Embedded 21st Century Skills in Science

According to the Partnership for 21st Century Skills resource and policy guide, the economy in which we live is "driven by innovation and knowledge, a marketplace engaged in intense competition, a society with complex business, political, scientific, technological, health, and environmental challenges and a diverse workplace and community, the ingenuity, agility and skills of our students who will be the future workforce are crucial". The growth in industry and creation of new jobs, many of which are not even known today, requires an education based on 21st century skills to allow the US to remain competitive. Between 1967-1997, there was a 20 percent increase in information services, from 36% to 56%. There has been a huge shift from manufacturing to services; between 1995 and 2005, the US economy lost three million manufacturing jobs and created 17 million service-sector jobs. These service sector jobs dominate the US economy at 86% of all jobs falling in this category. The skill demand has shifted as well. There is a significant increase in the number of workers who have at least some level of higher education (from 28% in 1973 to 59% in 2000) and the US Bureau of Labor Statistics who has identified 271 jobs with high-growth potential over the next 10 year, require at least some college education; most require one or more college degrees (2008).

In order to prepare students appropriately, every aspect of their education from preK-12, postsecondary, adult, after school and youth development, workforce development and training and teacher preparation programs must be aligned. The skills that will increase students' marketability, employability and readiness for citizenship include: critical thinking, the ability to solve complex, multidisciplinary, open-ended problems, creative and entrepreneurial thinking, communication and collaboration, making innovative use of knowledge, information and opportunities, and taking charge of financial, health, and civic responsibilities. These skills (listed below) will withstand the test of time, fluctuations in the economy and marketplace and dynamic employment demands.

- Core Subjects and 21st Century Themes
  - Global Awareness
  - Financial, Economic, Business and Entrepreneurial Literacy
  - Civic Literacy
  - Health Literacy
  - Environmental Literacy
- Learning and Innovation Skills
  - Creativity and Innovation
  - Critical Thinking and Problem Solving
  - Communication and Collaboration
- Information, Media and Technology Skills
  - Information Literacy
  - Media Literacy
  - ICT (information, Communications and Technology) Literacy
- Life and Career Skills
  - Flexibility and Adaptability
  - Initiative and Self-Direction
  - Social and Cross-Cultural Skills
  - Productivity and Accountability
  - Leadership and Responsibility

Science is seen as a promising context for teaching these skills because it is not only a body of accepted knowledge, but also involves processes that lead to this knowledge. Engaging students in scientific practices such as engaging in argument from evidence and communication information, developing and using models, planning and carrying out investigations, and constructing explanations, build science proficiency. At the same time, this engagement may develop 21st century skills. An example of this can be found in the National Research Council's Workshop Summary, Exploring the Intersection of Science Education and 21st Century Skills, "developing and presenting an argument based on evidence, as well as posing appropriate questions about others' arguments, may develop complex communication skills and nonroutine problem-solving skills" (2010).

Increasing the Representation of Minorities and Women in Science and Technology

MMSD has a highly diverse student population. By teaching science, we would engage minority students in fields in which they are currently underrepresented nationally. By capturing and engaging the imagination and curiosity of student at an early age, we hold open the doors of possibilities for future careers. This is greatly needed by the United States as more and more jobs are founded in the science, technology, engineering and mathematics fields.

The following excerpt from an article in the Baltimore Sun helps to illustrate this dynamic.

"It's well-documented that the United States needs a strong science and technology workforce to maintain global leadership and competitiveness," said Freeman A. Hrabowski III, president of the University of Maryland, presenting the report in Washington on Thursday. "The minds and talents of underrepresented minorities are a great, untapped resource that the nation can no longer afford to squander."

The report calls for a coordinated effort among the federal, state and local governments, K-12 school systems and universities.

The report calls on the federal government to sustain its stimulus-level funding of Head Start, to increase Title I funding for public schools, to offer incentives for math and science teachers in districts with large minority populations and to create 5,000 new college fellowships a year for minorities interested in science and technology careers.

"The hope is that we will see action by Congress," Hrabowski said in an interview Friday. "We need the nation to decide to invest substantially in educating these students."

State systems need to align their grade-school curricula with the science and math taught in early childhood programs such as Head Start, the report says. It also recommends that they introduce students to science and technology careers as early as pre-school.

Local systems should all provide science and technology magnet schools and encourage minority students to enter them, the report says. It also calls on them to provide one college counselor for every 250 students in middle and high school and to design specific programs for attracting minority students to science and technology [Baltimore Sun].

In Madison, we have many local examples of women and people of color who are highly educated and have rich and rewarding careers. The University of Wisconsin and the wealth of businesses and industries in the Dane County area can serve as resources for the district for the encouragement of students and the awareness and improved understanding of the conditions that are needed for all students, especially women and minorities, to find success in science fields.

Many of the tools needed to support learners from different cultural backgrounds are already in place in the district. Other teaching strategies need to be implemented with specific professional development to ensure fidelity. The learning and work of the District's Equity team need to be embraced by the science education program in order to better address science learning for all.

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Chapter 4

Partnerships and Community Connections

Why is this important?

Students must see science as relevant and meaningful to their lives beyond school in order to remain engaged as learners of science. Students build their classroom science learning on the foundations they have developed and continue to develop in their homes and communities. The connections between science, the home, and the community help students grow and develop their science identities in two ways: the parents of the students are enabled to be more involved in their childrens' learning, and the curriculum is relevant because it is informed by the current issues and concerns of families and community members.

There is increasing research that demonstrates that non-dominant students, in particular, are casualties if the bridges between science and the community are not put into place. This can be true in terms of selecting demanding science courses (Calabrese Barton et al., 2004) science enrichment, (Simpson and Parsons, 2008) and engagement with science content. (Rodriguez and Berryman, 2002).

For example, Rodriguez and Berryman found that tenth grade students demonstrated higher engagement and enhanced content learning when their science curricular unit investigated the water quality of the neighborhood watershed. Bouillion and Gomez (2001) similarly found increased engagement and understanding of American Latino elementary students when the science curriculum included solving real world community project-based about pollution. In this project, the curriculum included soliciting community members for advice.

Informal Science: A Critical Partner

The National Science Teachers Association (NSTA) recognizes and encourages the development of sustained links between the informal institutions and schools. Informal science education generally refers to programs and experiences developed outside the classroom by institutions and organizations that include:

- children's and natural history museums, science-technology centers, planetariums, zoos and aquaria, botanical gardens and arboreta, parks, nature centers and environmental education centers, and scientific research laboratories
- media, involving print, film, broadcast, and electronic forms
- community-based organizations and projects, including youth organizations and community outreach services

A growing body of research documents the power of informal learning experiences to spark curiosity and engage interest in the sciences during school years and throughout a lifetime. Informal science education institutions have a long history of providing staff development for teachers and enrichment experiences for students the public. Informal science education accommodates different learning styles and effectively serves the complete spectrum of learners: gifted, challenged, non-traditional, and second language learners.

NSTA strongly supports and advocates informal science education because a shared common mission and vision are articulated by the National Science Education Standards, as well as being important in the Next Generation Science Standards:

- Informal science education complements, supplements, deepens, and enhances classroom science studies. It increases the amount of time participants can be engaged in a project or topic. It can be the proving ground for curriculum materials.

- The impact of informal experiences extends to the affective, cognitive, and social realms by presenting the opportunity for mentors, professionals, and citizens to share time, friendship, effort, creativity, and expertise with youngsters and adult learners.
- Informal science education allows for different learning styles and multiple intelligences and offers supplementary alternatives to science study for non-traditional and second language learners. It offers unique opportunities through field trips, field studies, overnight experiences, and special programs.
- Informal science learning experiences offer teachers a powerful means to enhance both professional and personal development in science content knowledge and accessibility to unique resources.
- Informal science education institutions, through their exhibits and programs, provide an effective means for parents and other care providers to share moment of intellectual curiosity and time with their children.
- Informal science institutions give teachers and students direct access to scientists and other career role models in the sciences, as well as opportunities for authentic science study.
- Informal science educators bring an emphasis on creativity and enrichment strategies to their teaching through the need to attract their non-compulsory audiences.
- NSTA advocates that local corporations, foundations, and institutions fund and support informal science education in their communities.
- Informal science education is often the only means for continuing science learning in the general public beyond the school years.

These concepts can be found in the NSTA Position Paper on Informal Science Education (2011), available at: http://www.nsta.org/about/positions/informal.aspx. This paper is currently, at this writing, under review by the NSTA Board of Directors.

Who and What

There are many community partnerships that schools, classrooms and MMSD programs have utilized to enhance the study of county, and state agencies. Following is a *partial* list of community- based resources that have proven effectiveness with teachers when designing science units and with students as they learn science. This list was developed as the result of a brainstorming activity with the Science Program Evaluation Advisory Committee.

The shear volume of partnerships developed from the activity is proof of the broad scope of interests in the community that support science programming in MMSD. These partnerships between MMSD and others include institutes of higher education (both 2-year and 4-year degree institutions), private and non-profit organizations, as well as coordinated efforts between the city, county, and state governmental units. Dane County provides an abundance of opportunities!

The tables below represent just a portion of the strong support that the Science program within the district enjoys by the community. These relationships should be nurtured and cultivated so that Madison students may benefit from these partnerships for generations to come.

Partnership	Partner 1	Partner 2	Partner 3	Partner 4	Audience	Description
West High School Rocket Club	Pavel Pinka	Chris Hagar			West High students	Students design, build, and launch rockets to send experimental payload skyward.
Science Olympiad	Teachers at various district middle and high schools (local level)	State and national levels partner with various institutions			Middle and high school students	Teacher organizes club of students who research various academic and engineering/building projects in preparation for local, state, and national competition.
Professional development	District level	Science instructional resource teachers and high school department chairs from West, East, Memorial, LaFollette, and Shabazz			High school department chairs (teachers)	The focus of department chair professional development meetings is to provide support and learning opportunities to: – align curriculum, instruction, and assessment – develop slope & sequence within all content areas – deepen understanding of examining student work to improve instruction and learning – strengthen instructional leadership within the content areas across the district – understand processes and systems in order to provide leadership
Research Education Action and Policy on Food	MMSD	USDA	Local farmers	AMERICORPS	K-12 students, food service professionals, farmers	R.E.A.P.'s Farm to School Program is working to: – increase access to fresh, local,

Partnership	Partner 1	Partner 2	Partner 3	Partner 4	Audience	Description
Group Farm to School Program						and sustainably produced foods for WI school children through school meal and snack programs – explore opportunities to build reliable markets for local sustainable farmers and food processors within school food services – connect children with food and farmers by providing hands-on educational opportunities focused on the local food system and the connections between health, food, farms, and the environment
UW Geology Museum	UW Geology Museum staff and MMSD classrooms				Elementary classrooms	Guided tours of the geology museum around standards and content themes by UW students and UW staff.
Inquiry for the 21st century	UW-Madison	MMSD, New Century School	Delavan/Darian School District	School for the Deaf	K-8 teachers	A professional development opportunity for K-8 teachers to work together in groups on a science investigation incorporating active learning and critical thinking skills through scientific inquiry.
SMI (Science Masters Institute)	UW-Madison faculty	MMSD secondary	MMSD middle school	DPI	Middle school science teachers	30 hours of contact time, 1 UW credit, funded by DPI designed to increase

Partnership	Partner 1	Partner 2	Partner 3	Partner 4	Audience	Description
		science resource teachers	science teachers			background in areas of science taught through FOSS middle school curriculum at MMSD.
Expanding Your Horizons (EYH)	UW-Madison	Edgewood College	MATC, other school districts	MMSD, Covance	Middle school (grades 6-8 girls)	This is a day of career exploration activities in science, engineering, and mathematics for young women in middle school.
Manduca (Tobacco Hornworms) Raising Program	UW-Madison, Walt Goodman (Entomology professor)				Elementary students (Grades 1 & 2)	Walt Goodman, a UW-Madison professor in entomology, raises and supplies MMSD with manducas (tobacco hornworms) for the FOSS Insects module.
Wisconsin Fast Plants Program	UW-Madison Fast Plants Program	MMSD			K-12 students and teachers	The Fast Plants are a teaching tool with which to explore all aspects of plant growth and development while introducing students to the process of scientific investigation. Wisconsin Fast Plants are rapid-cycling brassicas, developed to be used by plant researchers and by teachers and students in the classroom.
"Waterdrop" Lady, UW Extension (water resources - free) - storm drain protection/watershed	UW Extension	MMSD			Classrooms in elementary school	Speaker comes to the class dressed as a waterdrop to discuss water quality and protection of area lakes. She gives classrooms a kit and directions on how to clean out and protect storm drains.
PEOPLE Program	MMSD	UW-Madison			Students in grades 6	PEOPLE offers both school-year and

Partnership	Partner 1	Partner 2	Partner 3	Partner 4	Audience	Description
					and above	summer opportunities for tutoring and enrichment courses. Students who successfully complete the program and get accepted to UW-Madison get a tuition/room/board scholarship.
Great Lakes Bioenergy Research Center Summer Institute	Great Lakes Bioenergy Research Center	Center for Biology Education			Science teachers, grades 6-college	Summer program for teachers. Provides background in biofuels production research and development focus on cellulosic ethanol production, curriculum materials available online (www.glbrc.org)
DOC's (Doctors Ought to Care)	UW Medical School	MMSD middle school classroom			MMSD classrooms	UW medical students trained to teach middle and high school students provide students with health related information (they bring human organs, if you ask).
Middle School Science Symposium	MMSD	UW-Madison, Wisconsin Institutes of Discovery (WID)	Institute for Cross-College Biology Education (ICBE)		6-8 grade students	An opportunity for students in grades 6, 7, and 8 to take part in a science research symposium. As individuals, pairs, or in groups of three, students follow the inquiry process, with the guide of a mentor, to investigate a science research project of their choosing.
Math/Science Title IIB Grant/Midwest Professional Development Hub	MMSD	UW-Madison, Educational Outreach Program (EOP)	CESA 2	WestEd	K-8 teachers	Making Sense of Science (MSS) is a comprehensive series of professional development courses that focus on core topics of K-8 earth, life, and physical science. Teachers who

Partnership	Partner 1	Partner 2	Partner 3	Partner 4	Audience	Description
						participate in these courses learn to facilitate hands-on science lessons, support evidence-based discussions, and develop students' academic language and literacy skills in science.
East NSBE - Junior Chapter Engineering Club	National Society Club of Black Engineers (NSBE)				9-12 students	Provide funding to do activities and field trips related to engineering – LEGO Robot competition (engineering design) – tutoring of students
SMART (Students Modeling a Research Topic	Milwaukee School of Engineering				High school science students	Research scientists work with students to model protein structures using software and molecular data to create 3D models.
East Pre-Engineering Club	NSBE	UW-Madison	MMSD East feeder middle schools		7-8 grade students (female and/or minority is target but takes up to 10 interested kids)	Middle school students travel to East High School once a month to participate with other students in engineering activities.
UW Student Teachers	UW-Madison	MMSD			K-12 educators/students	UW-Madison places practicum and students teachers in MMSD classrooms for field experience related to science instruction.
Summer Science Research	MMSD	UW-Madison			High school science students (MMSD),	Grade 10 and 11 students apply in December for UW laboratory research positions full-time the following

Partnership	Partner 1	Partner 2	Partner 3	Partner 4	Audience	Description
Internship					Grades 10 and 11	summer. Professors or graduate students serve as mentors.
UW-Endocrinology	UW Medical School	MMSD Cherokee Middle School			Researchers and general public	8th grade science class co-researchers/subjects in area of metabolic diseases. Students ask questions, keep journals, and collect and analyze data.
Institute for Chemical Education (ICE)	UW-Madison, Chemistry Department				K-12 students and teachers	ICE has activities and programs in chemistry for students and teachers.
Wonders of Physics	UW-Madison, Physics Department				K-12 students	The Wonders of Physics is a long-standing outreach effort of the Physics Department. They do school events demonstrating many principles of physics.
Research Experiences for Teachers	UW-Madison				K-12 teachers	Many UW-Madison programs offer summer research opportunities for teachers. These programs pay teachers a stipend to learn the science in the lab and to develop a lesson related to the science.
science.wisc.edu website	UW-Madison, Science Alliance				K-12 teachers and students	A portal to information on UW-Madison science outreach programs, activities, events, and people.
BioTrek	UW-Madison, Biotechnology Center				K-12 students	BioTrek is the outreach program of the UW-Madison Biotechnology Center. They offer workshops on campus for K-

Partnership	Partner 1	Partner 2	Partner 3	Partner 4	Audience	Description
						12 students.
Darwin Day	UW-Madison, Crow Institute Nescent	UW-Madison, Geology Department			Teachers and students	Worldwide day to recognize and honor the work of Charles Darwin through talks and activities with evolution.
Wisconsin Eye Research Institute (ERI)	UW-Madison				K-12 teachers and students	The ERI is beginning to develop activities to connect their research on the eye with K-12 audiences.
Materials Research Science & Engineering Center (MRSEC)	UW-Madison, College of Engineering				K-12 teachers and students	MRSEC is a national research lab with an explicit mission of sharing research in Materials Science & Nanotech with students, teachers, and the general public.
Junior Science Engineering and Humanities Symposium (JSEHS)	MMSD	UW-Madison, Educational Outreach Program (EOP)			6-12 students	High school and middle school students can learn about research and careers in science, engineering, and mathematics. They can attend workshops and learn from researchers, share poster presentations and research ideas, and possibly qualify for scholarships and awards.
Secondary Ed Partnership Schools	MMSD Middle/High Schools	UW-Madison, Secondary Ed Program			6-12 teachers, pre-service UW students	– UW resources, school-based PD needs – Schools support UW pre-service teachers in each building

Partnership	Partner 1	Partner 2	Partner 3	Partner 4	Audience	Description
Institute for Biology Education (IBE)	UW-Madison	IBE			K-12 students	IBE is a connecting/networking organization that links the resources of UW-Madison with K-12 partners.
Wisconsin Institutes for Discovery	WID staff	UW-Madison	WARF		K-12 students	The WID offers programs and spaces for science outreach activities.
Looking to Nature: Biomimicry for Educators	MMSD	UW Arboretum	Madison Children's Museum		K-12 teachers	A three-day training to learn about the discipline of biomimicry and how it can be incorporated into the classroom or an informed educational setting. This course explores the basic principles, case studies, and attitudes and beliefs of biomimicry as well as the exercises used to teach participants about biomimicry.
Adult Role Models in Science (ARMS)	CBE	MMSD	MSCR	Madison Children's Museum	K-8 teachers and students	A partnership program managed by the Center for Biology Education with the goal of enhancing science education. This group brings together a variety of community resources to help schools being science to life and involve teachers and students in meaningful hands-on experiences.
ROSE Project (Resources and Opportunities in Science Education)	Lincoln-Midvale African-American, Latino, and Hmong				Parents of elementary aged students in Lincoln-Midvale area	Edgewood Office of Science Outreach works with Latino, African-American, and Hmong parents to share with them the opportunities for their children in science, how to support their children in science, and are taken into a lab to

Partnership	Partner 1	Partner 2	Partner 3	Partner 4	Audience	Description
	parent support groups					do a fun, hands-on activity.
Edgewood Student Teachers	Middle & high school science teachers, Edgewood College				Secondary teachers in the district	ED student teachers work with student teaching cooperating teachers. Share information and best practices in science teaching.
Sustainability Leadership Program	Edgewood College	MMSD			School district employees interested in sustainability and particularly in taking a leadership role in their institution.	A graduate certificate program in sustainability leadership.
Summer Professional Development Courses	In-service teacher, Edgewood College				Science teachers increasing skills, knowledge in some area	Varied courses offered in the summer at a special professional develop rate. Usually a week or two long focused on a particular topic.
STEM grant (Bilingual)	Teachers, Edgewood College	MMSD			Teachers interested in increasing skills in Bilingual education in science	Beginning in 2011, a 5 year grant to increase the number of teachers certified in ESL. Special focus on STEM activities.
Edgewood Science Olympiad Regional	Regional high schools				Advanced, interested, and motivated science	Edgewood hosts the Regional Science Olympiad competition in February. Successful teams move on to the State

Partnership	Partner 1	Partner 2	Partner 3	Partner 4	Audience	Description
Tournament					students	competition.
C-TELL (Connecting Teachers of English Language Learners)	Edgewood College and K-12 Educators from a wide variety of districts)	MMSD			K-12 educators	Educators in MMSD and other districts can participate in the C-TELL program to take coursework related to the education of English Language Learners. Educators get reduced tuition and courses are taught in a blended face-to-face/online format.
Conversations in Science	MMSD	Edgewood College	UW – Madison and Science is Fun		Science teachers of MMSD & Edgewood	Monthly meeting at Edgewood. Speaker (scientist) who is a science/researcher engages in conversation with the audience of Dane County teachers in a talk on a current project.
Cherokee Middle School - after school science	Edgewood Office of Science Outreach				Small group of Cherokee Middle School students interested in science	Cherokee middle school students come to Edgewood College for after-school programs in science.
Lussier Community Partnership	Lussier Community Center	Edgewood Office of Science Outreach			Students of Jefferson Middle School	Edgewood college students provide after school programs in science. Students come to Edgewood College for select activities.
Family Science Night at Edgewood	MMSD	Private schools	Organizations that work with families	Edgewood Office of Science Outreach	Families with children or other adult-child groups	Forty exploration stations fill the Sonderegger Science Center on the Edgewood College campus. Over 300 guests experience hands-on science in a fun, festival-like atmosphere. Open to the public. Held each April.

Partnership	Partner 1	Partner 2	Partner 3	Partner 4	Audience	Description
Masters in Education (PD)	In-service teachers, Edgewood College				In-service teachers	Professional Development Masters program. Core classes and area of concentration on providing high quality professional development.
Edgewood Campus Visits	Schools close to Edgewood campus				Students of the schools near Edgewood	Teachers bring their students to the Edgewood campus to study the lake, Wingra watershed. The many environments represented on campus, work at the Mazzuchelli Hall or the Sonderegger Science Center.
Edgewood Sustainability Tour	Edgewood Office of Science Outreach	Neighbors	MMSD		Anyone interested in the sustainability work on the Edgewood Campus	Virtual Reality tour of the Edgewood Campus. Paper tour of Boardwalk and Marsh are also available. Descriptive signage along boardwalk and Marsh.
Edgewood Annual Science Camp	Students K-8 in the MMSD district	Edgewood Office of Science Outreach			Students grades K-8	Science camps for children found or select topics in science and annually held on the Edgewood Campus each summer.
G.R.O.W. (Grass Roots Outdoor Wonder) Coalition	MMSD	Sustain Dane			Educators, parents, professionals, or youth interested in promoting outdoor learning	Networking gatherings held to share ideas and connect with other community members. Developing on-line school/youth garden resource. Hosts occasional youth garden tours.
Trees for Tomorrow Natural Resources Education Center in Eagle Wisconsin	8th grade Cherokee students	Trees for Tomorrow	MG&E	Cherokee PTO	8th grade Cherokee students	Students participate and acquire skills needed to explore and appreciate the natural world. Includes skiing, snow shoeing, and classroom.

Partnership	Partner 1	Partner 2	Partner 3	Partner 4	Audience	Description
People, Power, Planet	MMSD	Sustain Dane	McKinstry Group		MMSD staff and students K-12	McKinstry Group is consulting with MMSD to bring a comprehensive energy conservation program to all MMSD schools. Sustain Dane is coordinating teacher training.
Healthy Food Initiative	MMSD	MACSAC	REAP	Sustain Dane	K-12 district-wide	Working together to improve the quality and variety of foods offered to students for snacks and lunches in MMSD.
School Sustainability Initiative	MMSD	Sustain Dane	Edgewood College		District leadership	Development of District Sustainability Plan, increase knowledge in district of sustainability, support, and drive forward sustainability in the district.
Kearn Foundation	MMSD	Kearn Family Foundation			6-12 schools	Kearn Foundation provides grant funding for the implementation of Project Lead the Way courses in schools.
MacKenzie Environmental Center	MMSD	MacKenzie Environmenta l Staff			K-12 students	Field trip opportunity to immerse students in environmental education. Hands-on experiences and small group workshops available. MacKenzie Center staff can either facilitate the activity or teachers can print off activity and lead it themselves.
Nature Net	Aldo Leopold Nature Center	Parents of MMSD and surrounding	Students of MMSD and surrounding		Students, families, and teachers	Provide an on-line resource of area opportunities about nature and outdoor education for students, teachers, and

Partnership	Partner 1	Partner 2	Partner 3	Partner 4	Audience	Description
		areas	areas			their families.
Life Science	Aldo Leopold Nature Center	MMSD	Other area school districts		Elementary students in the MMSD schools and surrounding area	Naturalists provide guided tours and programming around life science content, including hands-on materials, outdoor education, and literacy connections.
Field Trip Transport Grants	Aldo Leopold Nature Center	Classroom teachers	Student teachers		Classrooms in elementary school & teachers	Provide transportation to the Aldo Leopold Nature Center for outdoor education and programming around life science.
Climate Education Center	Aldo Leopold Nature Center	Teachers	Students, families, and after school clubs		Students--elementary/middle school classrooms and families in the community and larger area.	The newly opened center features a philosophy of "high tech meets high touch". Focus on understanding human impact on climate over time.
Aldo Leopold Nature Center	East High School				12th grade students traveling on the Smoky Mountain trip	ALNC provided a grant for a bus and time at the center in order to train students traveling on the Smoky Mountains in outdoor/wilderness survival skills.
Youth Grow Local	Community Groundworks (Troy Garden)				K-12 students, interested community members, non-formal science/sustain interested.	Local conference on connecting gardening with schools/classrooms.
Seed to Table	Community Groundworks	MMSD			High School students	Development of curriculum to help infuse school gardens into the

Partnership	Partner 1	Partner 2	Partner 3	Partner 4	Audience	Description
	(Troy Garden)				and teachers	classroom (on Troy Garden's website.
Audubon - bird studies	Audubon	MMSD classroom teachers			Students in MMSD	Provide speakers, slides, descriptions, and photos of birds and bird calls plus lead the class in a "bird walk" to identify area birds. Provide classrooms with binoculars and resources about birds.
KEEP Programming/UWSP	UWSP, Focus on Energy				K-12 teachers	Professional Development: courses on Energy Education in classroom/school -- renewable energy. Lesson Plan resources. Grants, fundraisers, and scholarships.
LEAF	UW-Stevens Point				K-12 students	LEAF connects educators in Wisconsin with quality forestry education materials.
Field trips to Madison Children's Museum	Madison Children's Museum				K-5 students	Exhibits and programs that provide hands-on exploration and problem-solving. The exhibits complement classroom curriculum and support the Wisconsin Model Academic Standards.
Friends of the Madison School Forest (FOMSF)	MMSD	FOMSF			District-level	Provides "2nd trip" transportation through mini-grants so that teachers can take their students a second time to the Madison School Forest.
Promega/BTCI Field Trips	Promega	MMSD			9-12 students	1) Biotechnology field trips with hands-on lab experiments; 2) Youth Apprenticeship Program in Biotechnology; 3) African American

Partnership	Partner 1	Partner 2	Partner 3	Partner 4	Audience	Description
						Ethnic Academy summer program; 4) Stem Cell Symposium; 5) Bioethics Forum; 6) Protcomics Forum
Biopharmaceutical Technology Center Institute	Promega	MATC	UW-Madison, African American Ethnic Academy		9-12 teachers	Teacher workshops, Stem Cell Symposium, Bioethics Forum, Proteomics Symposium.
School Gardens	MMSD including Building Services	Fiskars	UW-Extension	GROW Coalition, Community Groundworks, others	Students, staff, parents from MMSD schools.	School gardens of many shapes and sizes are forming at our schools or have existed for many years at some sites. Programs run during the school day, after school, and in some cases over the summer months; food preservation classes have been added in some places. The GROW Coalition from Sustain Dane did an inventory and short summary of all MMSD gardens in summer 2011 (contact Rachel Martin at Sustain Dane).
Field trip to sewage plant	Madison Water Utility				K-5 students	Students tour the sewage plant.
MG&E Solar in Schools	MMSD	Other area school districts	MG&E		Primarily high school teachers	MG&E put in place and maintains solar photovoltaic panels on about a dozen area high schools. MG&E provides access to real time and historical data for the panels. In the past, there has been an annual competition in which students predict the performance of

Partnership	Partner 1	Partner 2	Partner 3	Partner 4	Audience	Description
						their school's panels on Earth Day. This program has been in place since about 2001 and more information and access to data monitoring is available at the MG&E website.
MG&E Electricity Presentations	MG&E				4th and 5th graders completing the Mag. and Elect. Unit.	A representative from MG&E travels to elementary schools with a "Safety House" to talk about being safe with electricity. The presentation does not cover information about circuits, etc.
Project Lead the Way (PLTW)	National PLTW Program	Local practicing engineers			Grades 6-12 teachers	Project Lead the Way is a program designed to foster interest and background in engineering fields for students in middle and high school (primarily high school). The program has a wide offering of well-defined courses supported by a national curriculum and course exit exams. Some of the later courses utilize design projects that enable students to be mentored by local engineers. This program is supported in part by private foundations. PLTW is also adding biotechnology and this may be running in partnership with the Gammon Road/Mineral Point campus of Madison college. These points need clarification or more detail. Summer training institutes at MSOE in Milwaukee and a fall conference provide professional development.

Partnership	Partner 1	Partner 2	Partner 3	Partner 4	Audience	Description
						Biotechnology and Biomedical Sciences are other options.
Upham Woods	K-12 MMSD Educators	UW-Extension			K-12 students	An opportunity for students to take part in environmental and leadership activities. In small groups, students interact with the environment while immersing themselves in the natural surroundings.
Earth Partnerships for School (EPS)	MMSD	UW-Arboretum	Other school districts in WI, US & internationally		K-12 teachers and students	EPS applies best practices in education and collaborates with K-12 teachers, students, and other community members to enhance learning through the process of restoring native habitats as outdoor classrooms.

An Example of one partnership

Community partnerships and informal educational opportunities in science don't have to stop at the end of the school day. They can be extended through the students' after-school programming and into the weekend, too. One example of a community science connection serving students in MMSD after school hours is the availability of science clubs which are organized in part by the ARMS partnership.

ARMS

Adult Role Models in Science (ARMS) is a partnership program managed by the Center for Biology Education with the goal of enhancing science education for children and families in the Madison area. ARMS was initiated in 1990 as a partnership between the UW-Madison Center for Biology Education, the Kiwanis Club of Downtown Madison and the Madison Metropolitan School District to enhance science instruction at high needs schools. ARMS has since expanded to serve the needs of after-school programs by leading After-School Science Clubs. The long-term goal is to impact all Madison children, focusing first on high-needs elementary and middle schools, boosting science literacy through university and community partnerships.

After school science clubs

A two-semester Service-Learning course supports undergraduate and graduate students to lead 8-week After-School Science Clubs each semester that have lasting impact on children's learning and motivation. University students taking the course serve as leaders of After-School Clubs that have been put into place at schools across the district. These clubs provide extra science activities designed to raise interest, foster curiosity, and provide rich experiences in science to any student that attends.

This program has proven valuable on many levels. First, University students are able to practice leadership skills, working with children in a structured setting, and giving back to the community. The District benefits in that students gain first-hand experience with science concepts that reinforce what is typically taught in a science classroom. Finally, students and families benefit, as students have a safe and engaging place to go after school and parents know that their children are actively learning science in a fun and exciting environment.

Chapter 5

Data and Findings

This chapter is about both the data that was used by the committee in its work and the findings supported by the data. This data reflects only a snapshot of the long term data available from some sources. At the same time, it shows that there are only a few data sources that relate directly to the K-12 science program..

For all the WKCE graphs that follow, all student data is for the Full Academic Year (FAY). This represents students that have been in the school since the September before the current testing year. For example, students taking the WKCE in November of 2011 need to have been in the district since September, 2010.

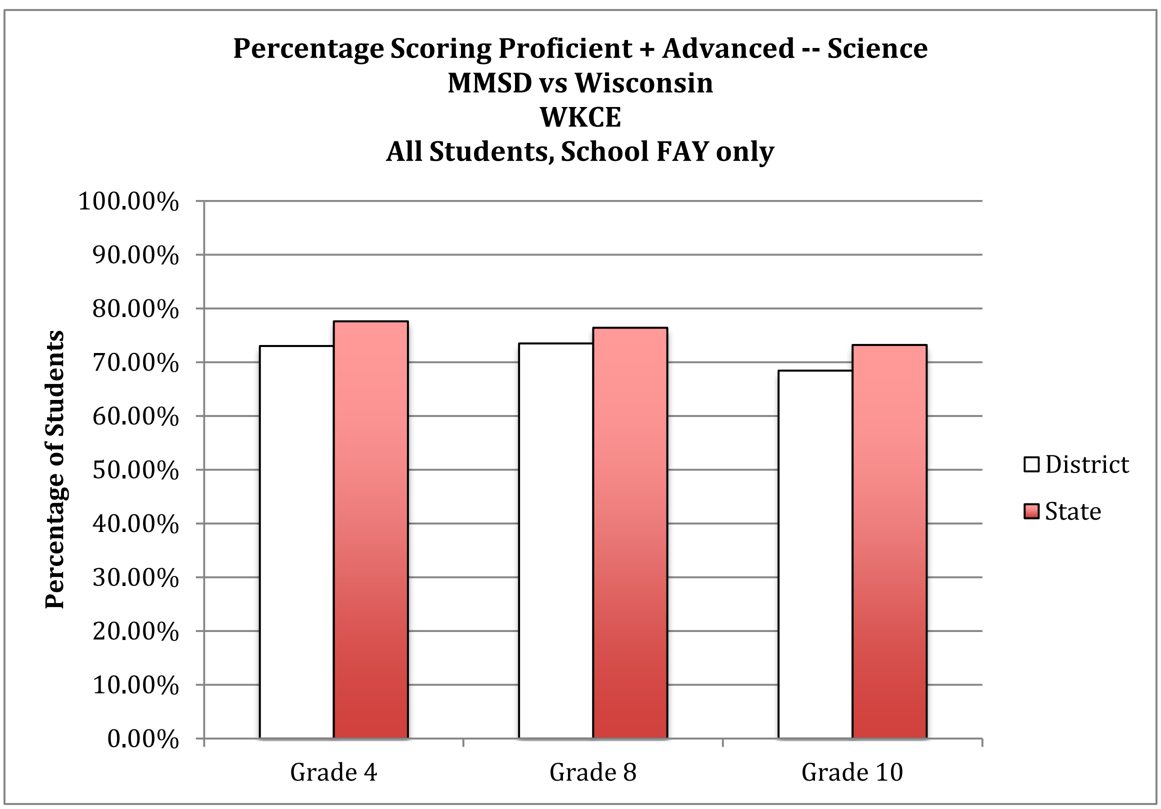
All FAY Students

For all grades tested, proficiency at the district level ranks below the state average on the 2010 WKCE. This shortfall ranges between three and five percentage points.

Overall, the percentage of students at proficient and advanced remains consistent for 4th and 8th grades, decreasing slightly at 10th grade.

The trend in percentages among MMSD students mirrors those of students state-wide.

There are no Adequate Yearly Progress (AYP) goals for science.

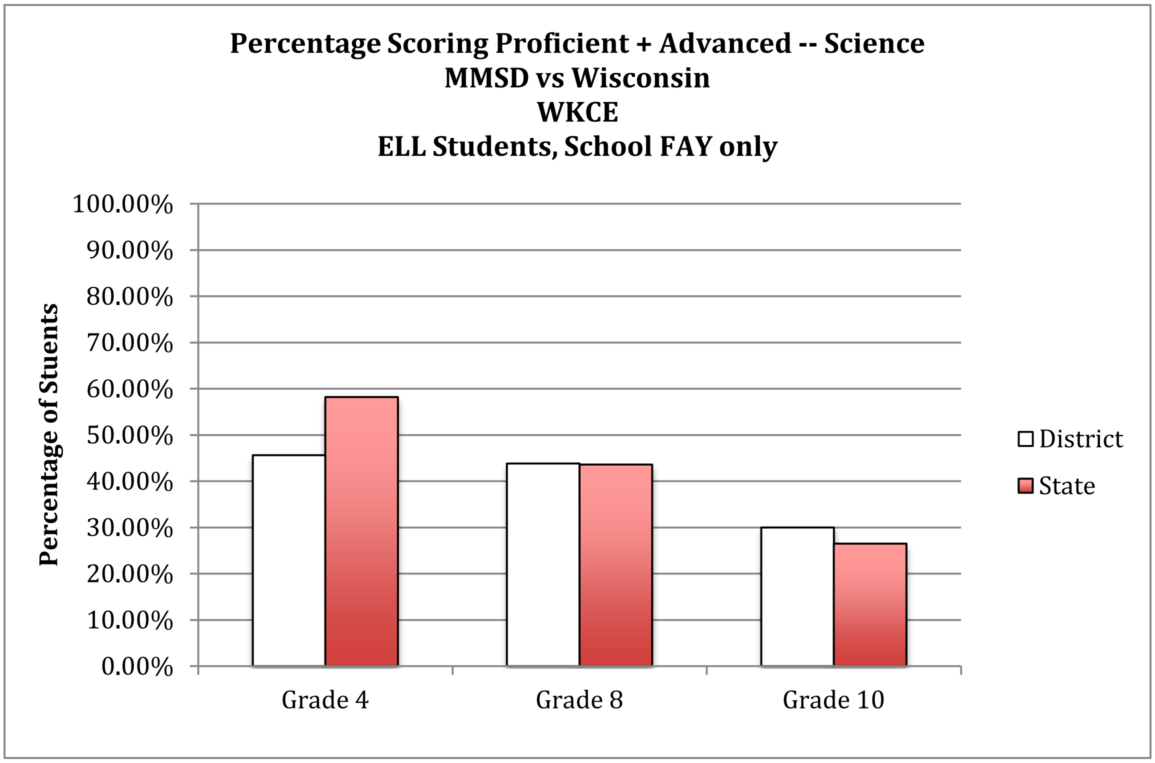


Source: DPI's WINSS site for 2010-2011 school year

English Language Learners, Grade 4

For all grades tested, proficiency at the district level ranges from higer than the state average to below the state average on the 2010 WKCE. This range lies between four points above, to essentially equivalent, to 13 percentage points below.

While MMSD students start lower in grade 4, the trend follows the same pattern as the state. These scores steadily drop from 4th to 10th grade. MMSD percentages do not drop at the same rate as the state.



Source: DPI's WINSS site for 2010-2011 school year

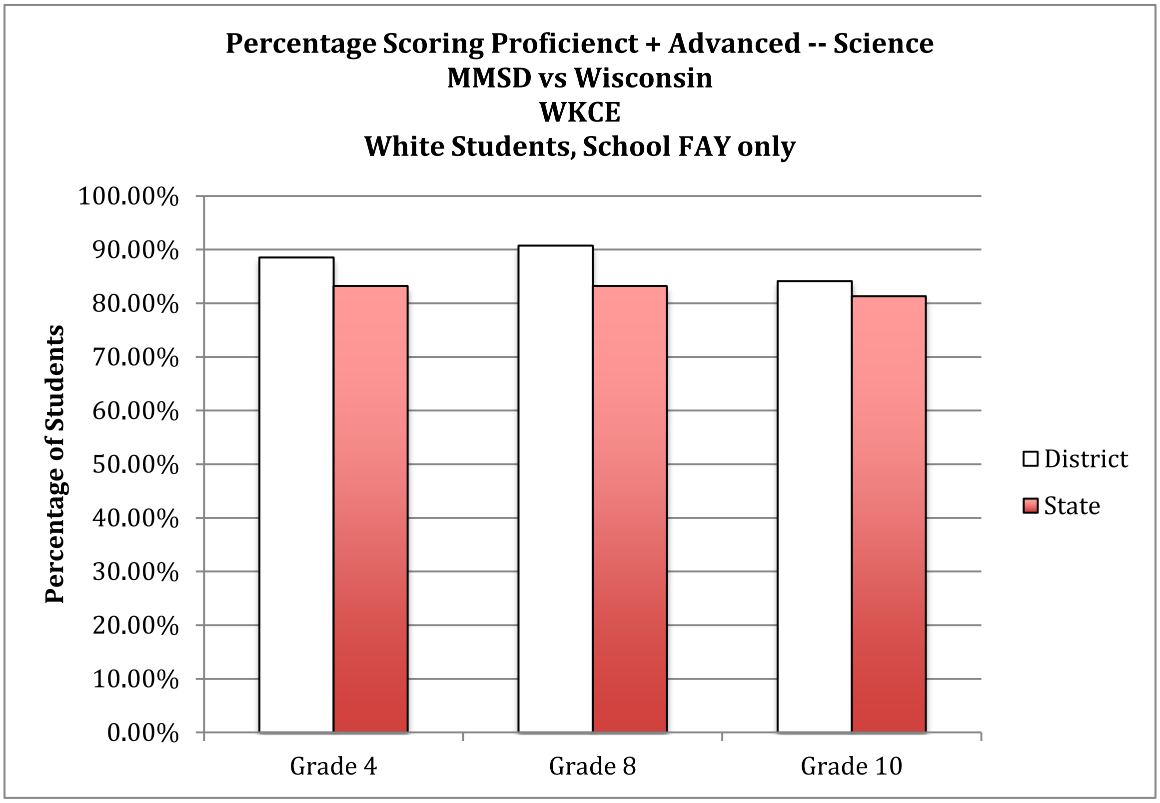
Ethnicity

White Students

For all grades tested, proficiency at the district level ranks higer than the state average on the 2010 WKCE. This range lies between three to seven points above the state average.

The greatest difference appears at the Middle School level, which has the highest percentage of all three grades assessed.

The MMSD results do not reflect the state trend, which holds steady for 4th and 8th grade and dropping slightly in 10th grade. MMSD sees a larger drop in percentages between 8th and 10th grades.



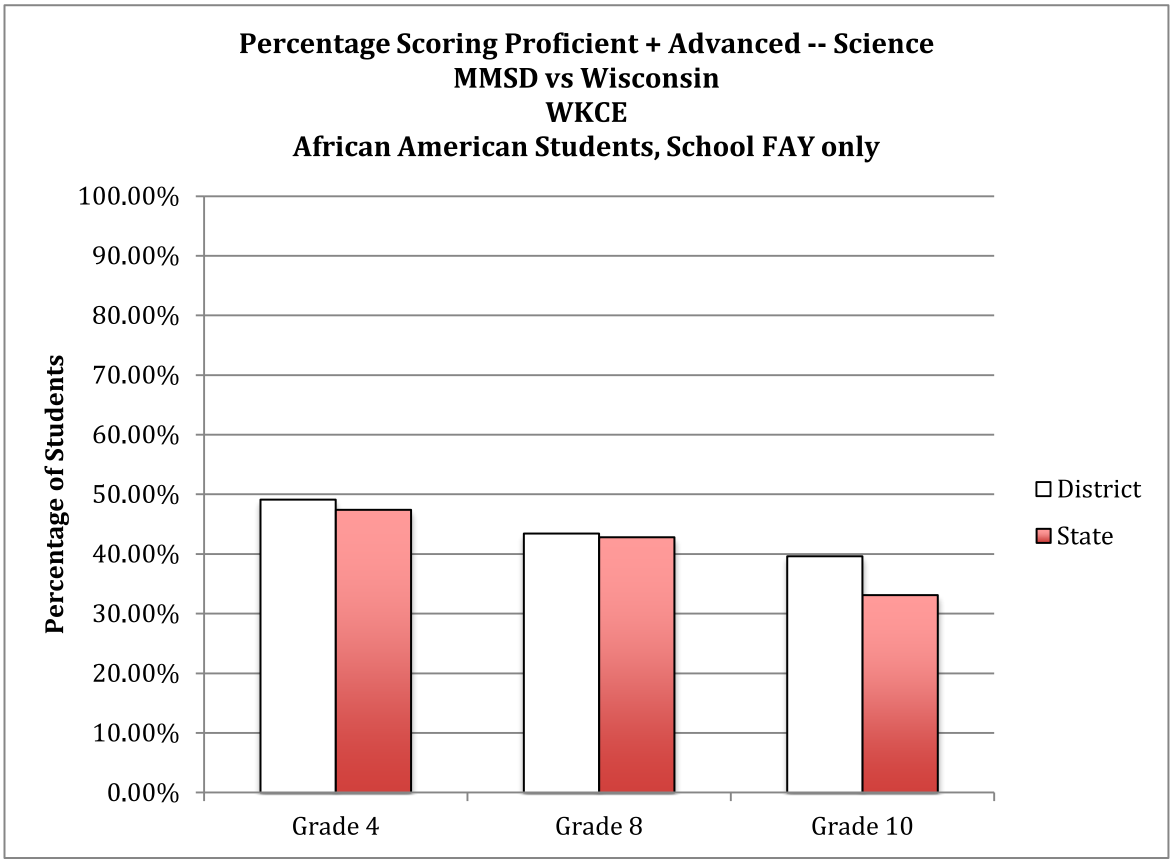
Source: DPI's WINSS site for 2010-2011 school year

African American Students

For all grades tested, proficiency at the district level ranks higer than the state average on the 2010 WKCE. This range lies between one to six points above the state average.

In none of the grades tested does the percentage of proficient and advanced African American students reach 50%. The decline in scores between 4th and 10th grade is approximately ten percentage points.

This reflects the state trend in scores dropping from 4th to 10th grade, however the drop is not as much with MMSD 10th grade students.

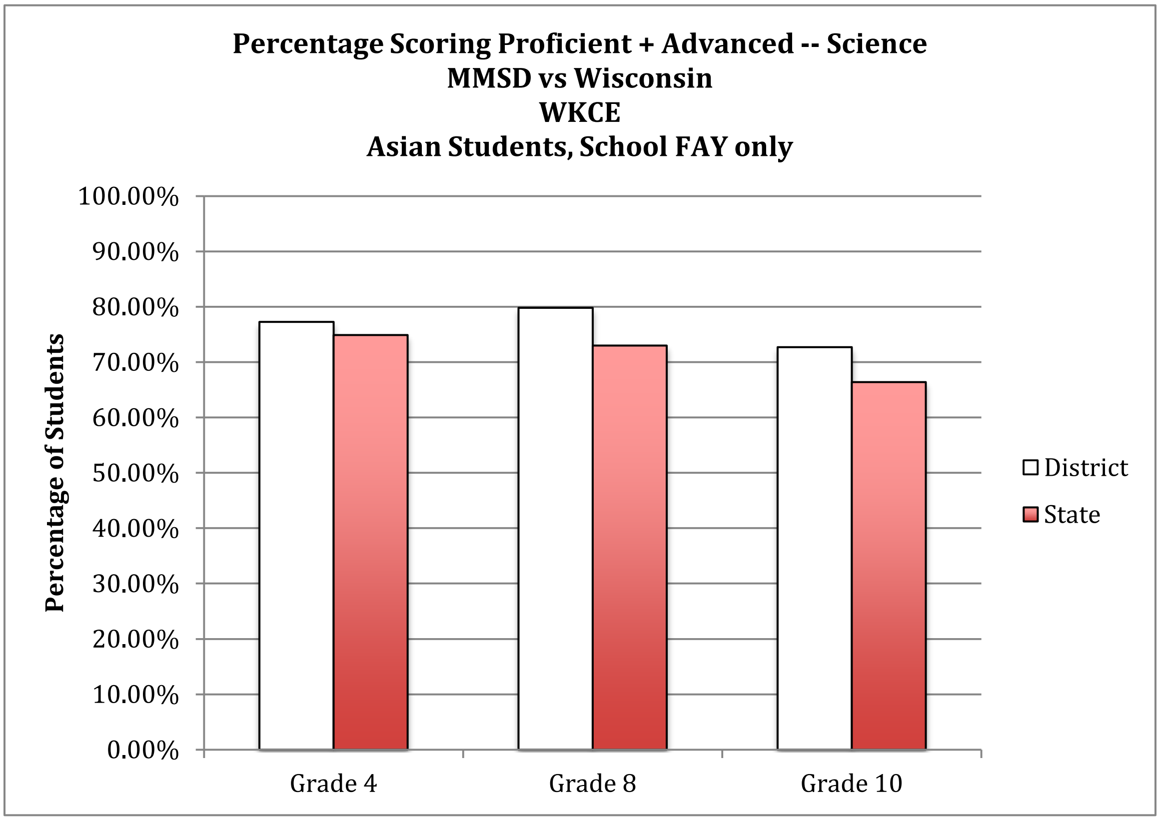


Source: DPI's WINSS site for 2010-2011 school year

Asian Students

For all grades tested, proficiency at the district level ranks higer than the state average on the 2010 WKCE. This range lies between three to six points above the state average.

There is a notable increase in the percentage of proficient and advanced students at the Middle School level. This then drops off in 10th grade. This does not reflect the state trend, which sees a steady decline from 4th to 10th grade.

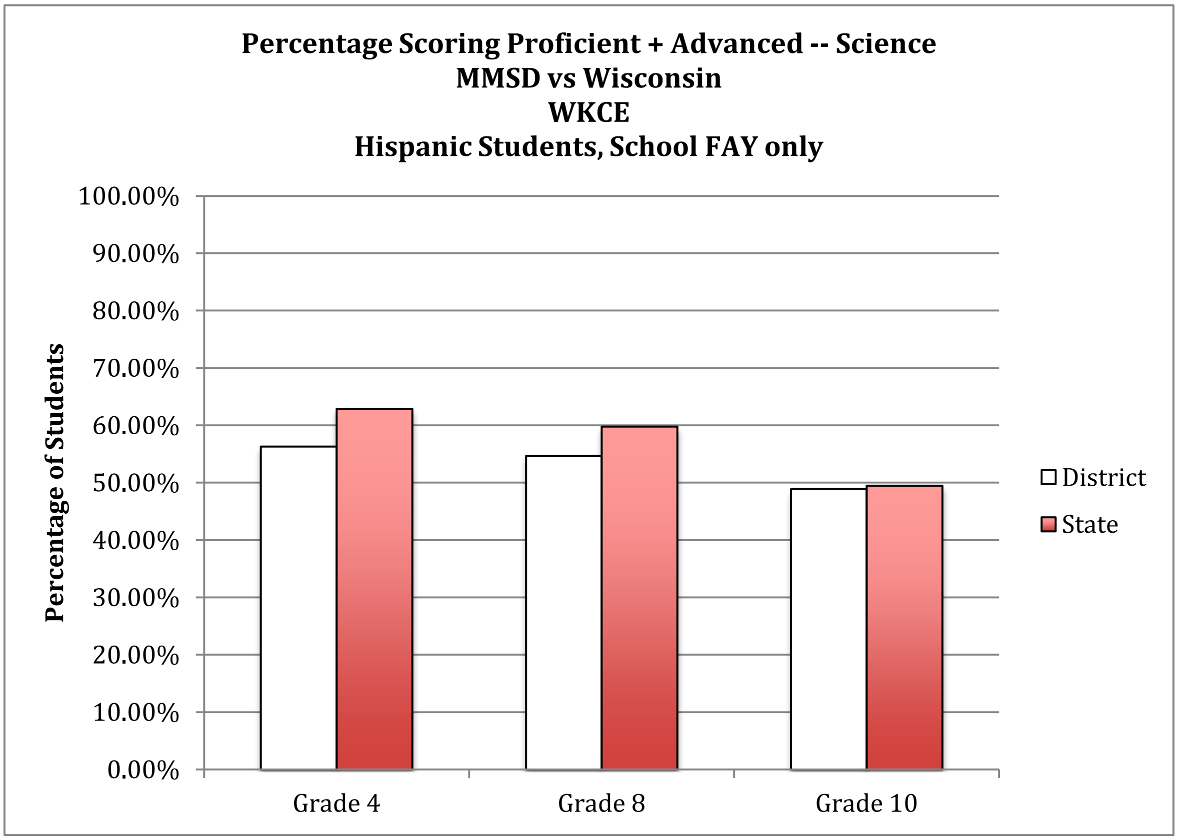


Source: DPI's WINSS site for 2010-2011 school year

Hispanic Students

For all grades tested, proficiency at the district level ranks lower than the state average on the 2010 WKCE. This range lies between zero to six points below the state average.

While the MMSD students follow the same trend as the state (declining from 4th to 10th grade), they are below the state average in all grades.

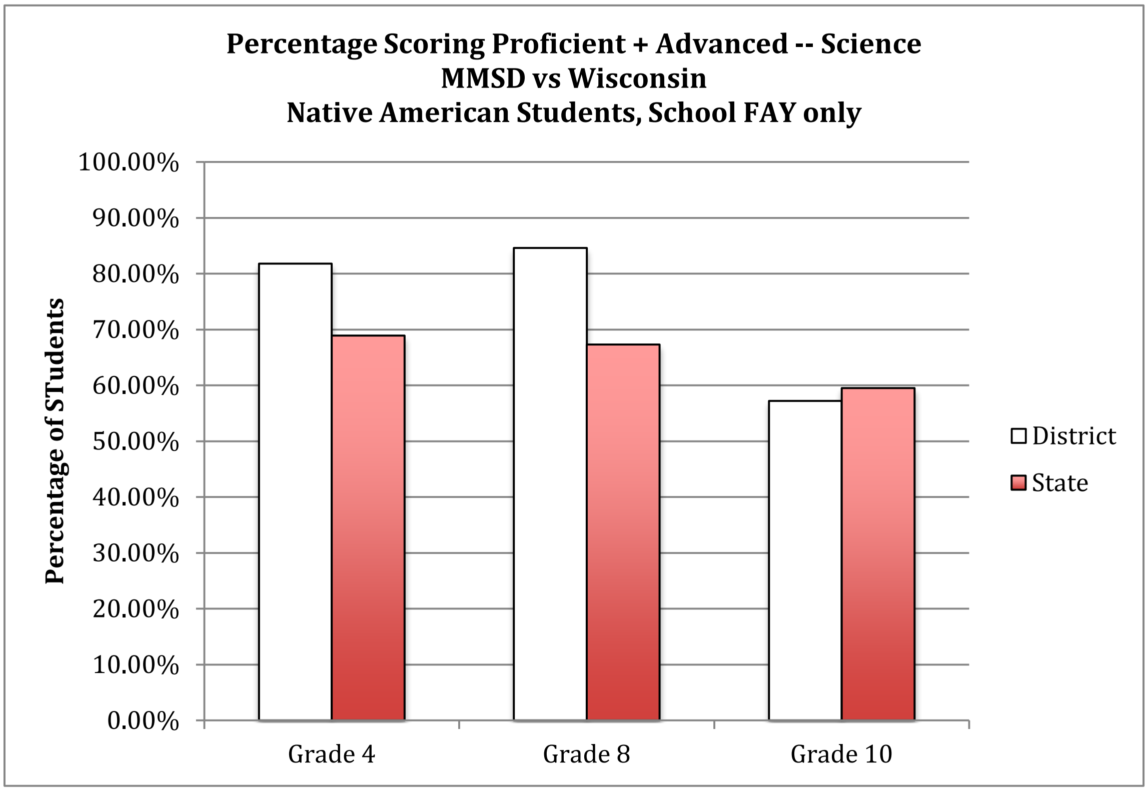


Source: DPI's WINSS site for 2010-2011 school year

Native American Students

For all grades tested, proficiency at the district level ranges from higher to lower than the state average on the 2010 WKCE. This range lies between two points below to 17 points above the state average.

The MMSD trend clearly does not follow the state trend. MMSD students improve the percentage proficient and advanced from 4th to 8th grade while the state shows a decline. However, MMSD students take a large drop between 8th and 10th grade. This 27 point drop is much larger than the states decline between the same grade levels.

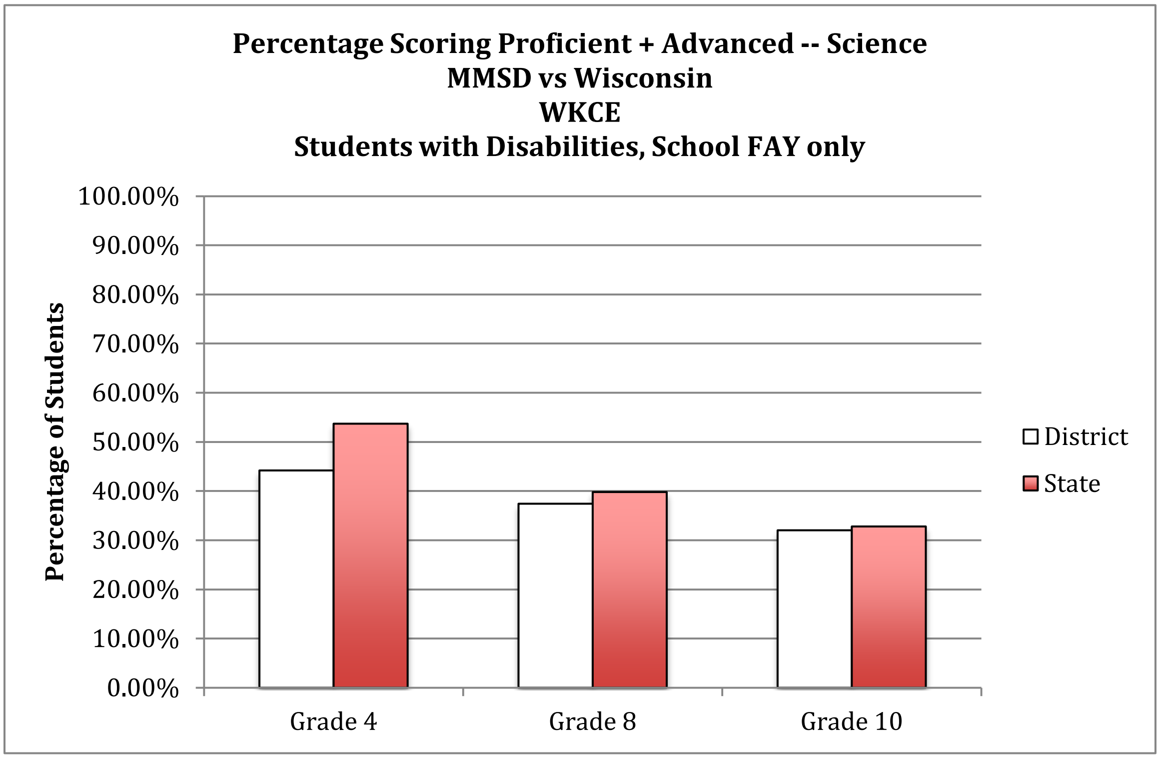


Source: DPI's WINSS site for 2010-2011 school year

Students with Disabilities

For all grades tested, proficiency at the district level ranks lower than the state average on the 2010 WKCE. This range lies between zero to nine points below the state average.

While mirroring the declining trend of the state, MMSD has fewer students at proficient and advanced at all grade levels.

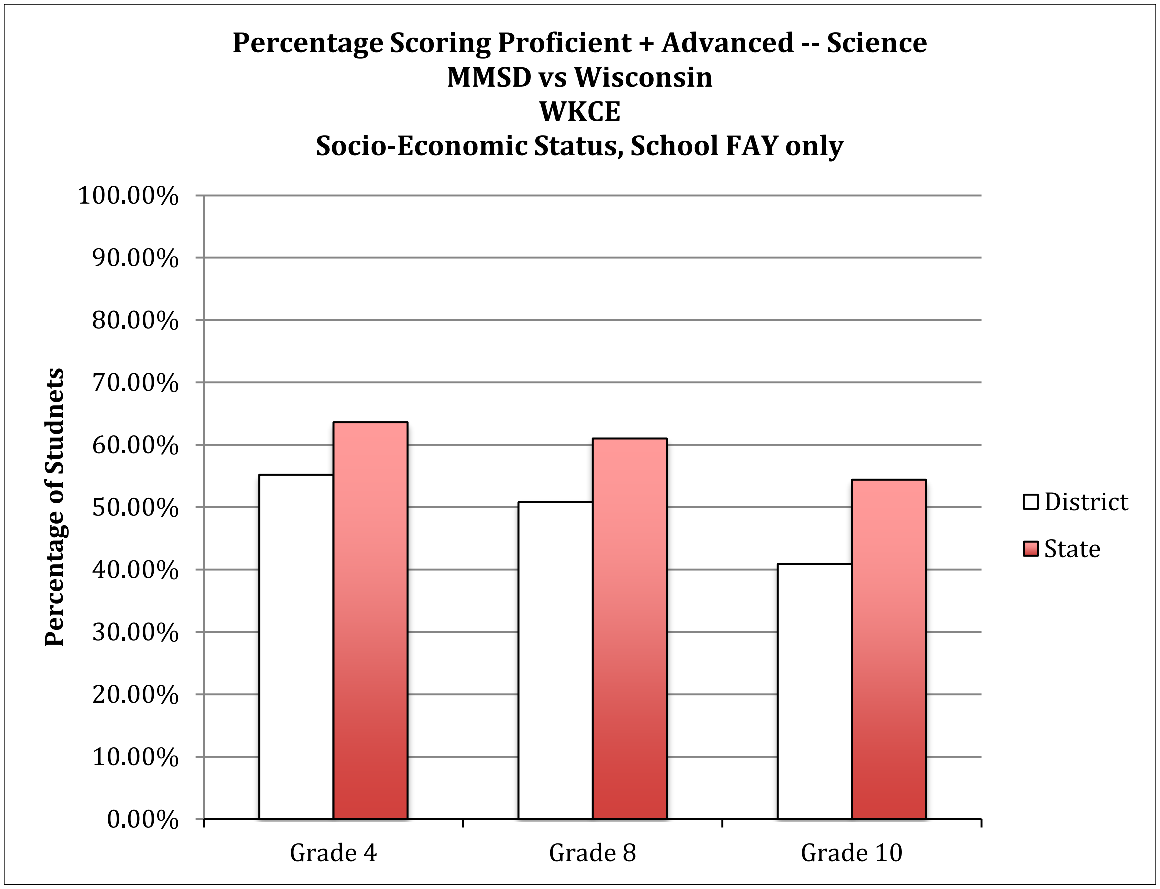


Source: DPI's WINSS site for 2010-2011 school year

Socio-Economic Status

For all grades tested, proficiency at the district level ranks lower than the state average on the 2010 WKCE. This range lies between eight to 14 points below the state average.

While the MMSD trend follows the state, it declines at a faster rate than the state trend.



Source: DPI's WINSS site for 2010-2011 school year

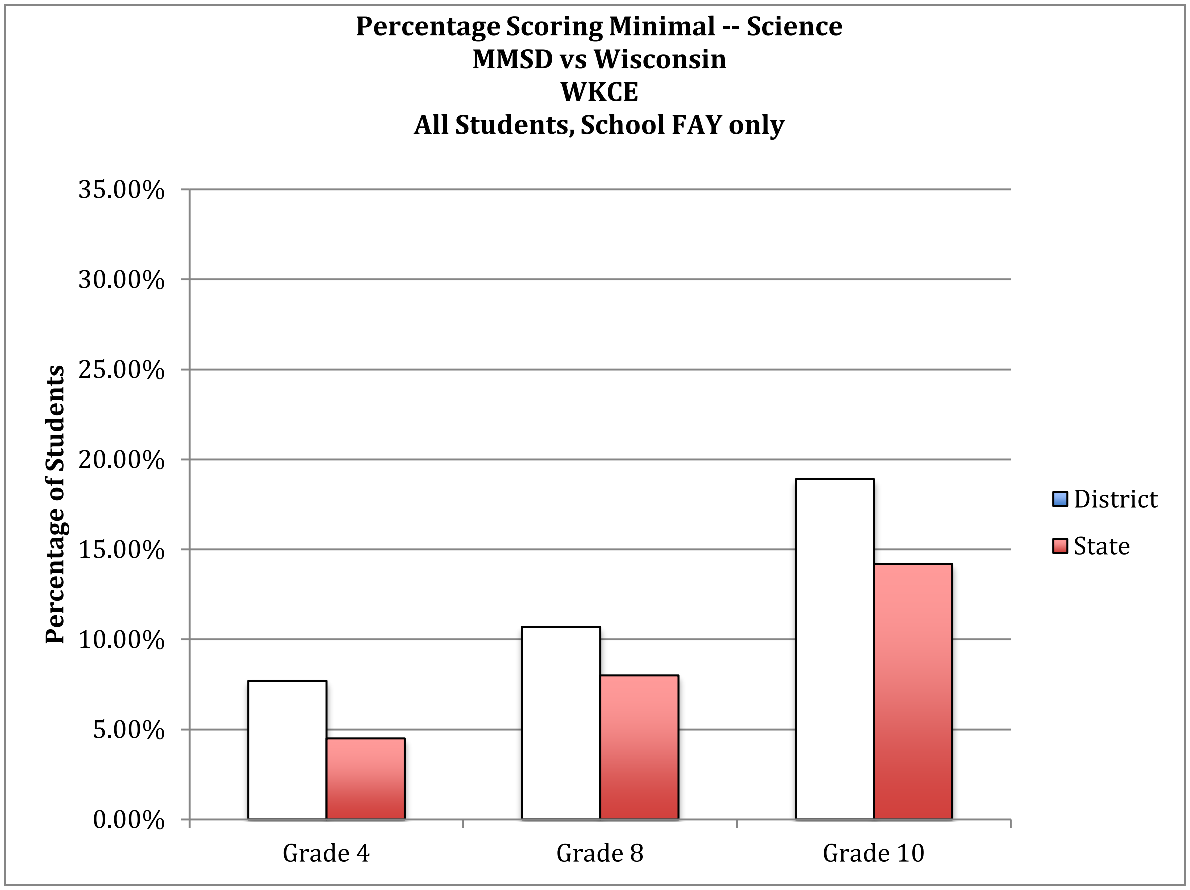
Minimal Proficiency

While viewing percentages of students scoring proficient and advanced on the WKCE is important, another aspect looks at the students who are not progressing. Students who are performing at the minimal level need to be supported as they move into proficiency.

All Students

For all grades tested, percentage of minimal scores at the district level ranks higher than the state average on the 2010 WKCE. This range lies between two to four points higher than the state average.

This follows the trend that more students are not meeting proficiency as they progress through school, from 4th to 10th grade.

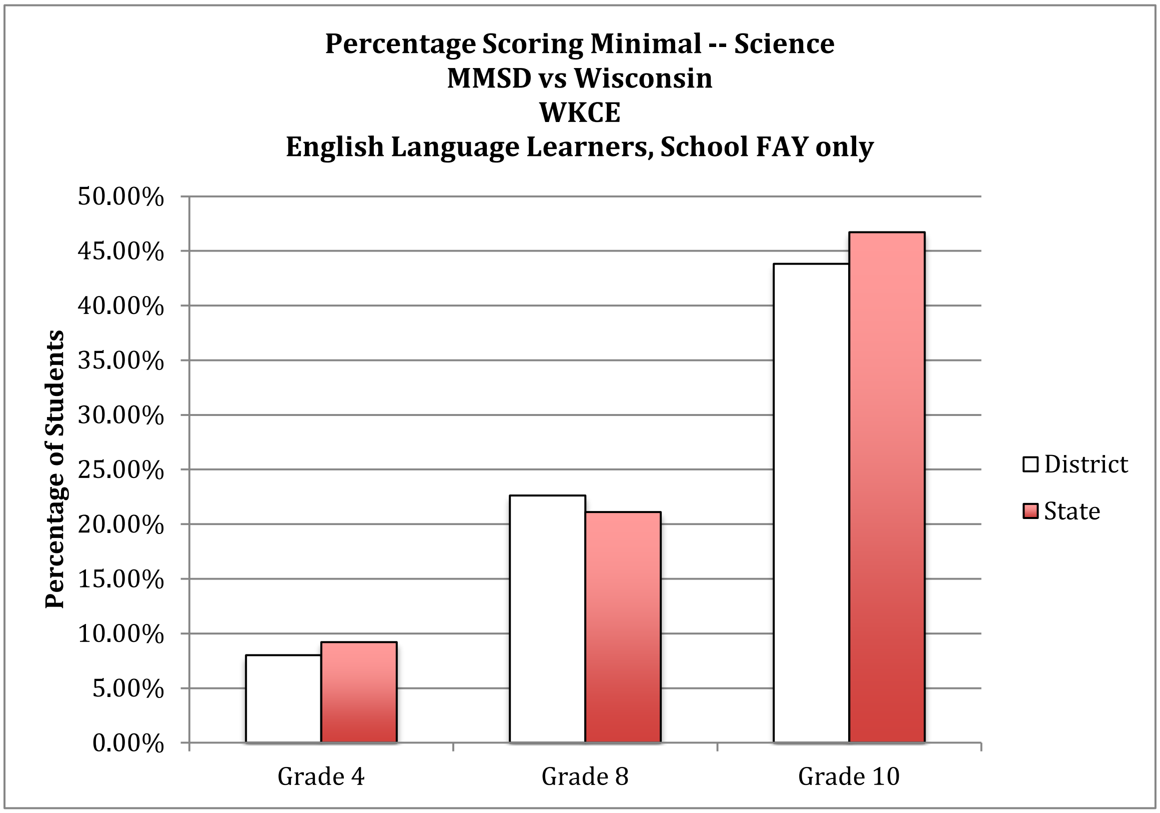


Source: DPI's WINSS site for 2010-2011 school year

English Language Learners

For all grades tested, percentage of minimal scores at the district level ranges from lower to higher than the state average on the 2010 WKCE. This range lies between three points lower to one point higher than the state average.

While MMSD follows the same general trend as the state, it shows variance in the range of the change. Ultimately, nearly 45% of 10th grade ELL students are not making progress toward proficiency.\



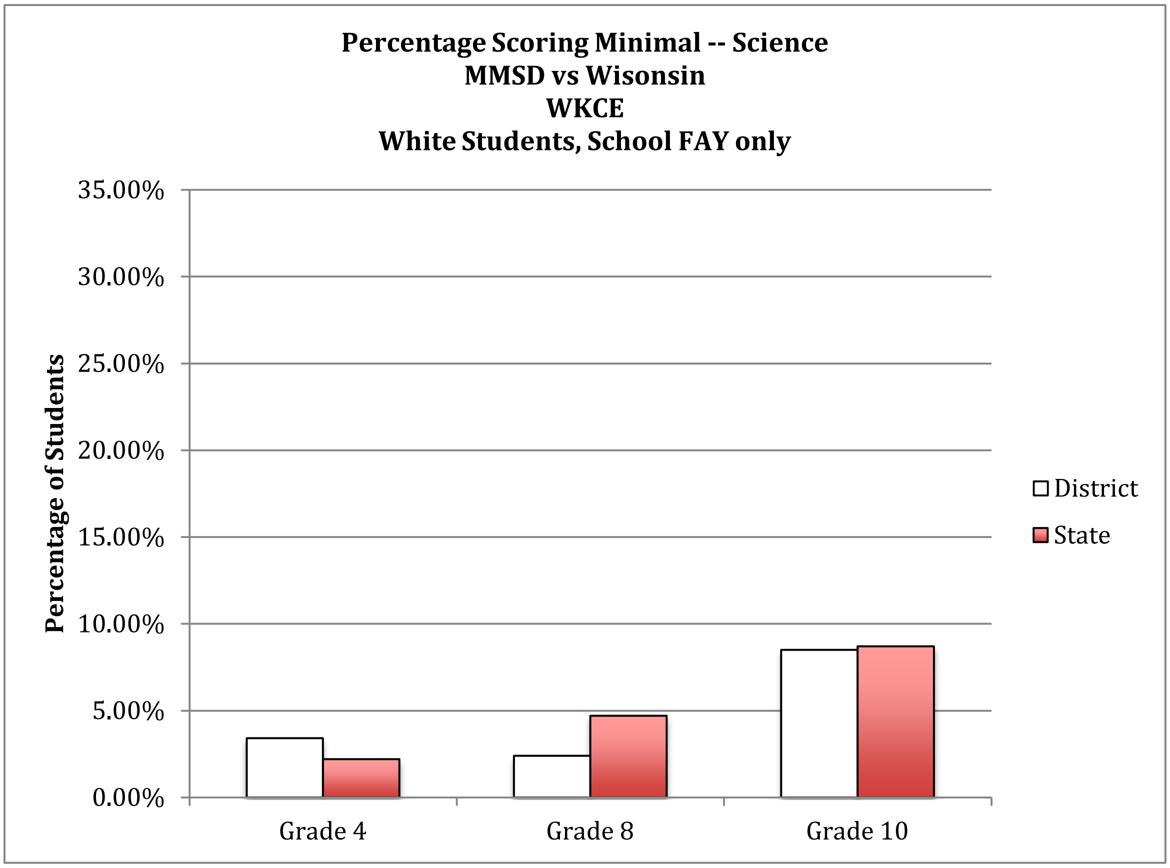
Source: DPI's WINSS site for 2010-2011 school year

Ethnicity

White Students

For all grades tested, percentage of minimal scores at the district level ranges from lower to higher than the state average on the 2010 WKCE. This range lies between one point lower to two points higher than the state average.

MMSD 10th graders mirror the trend of the state; however, having fewer students at minimal in 8th grade stands out as being a positive move forward. This has been consistent in MMSD for the past three years.

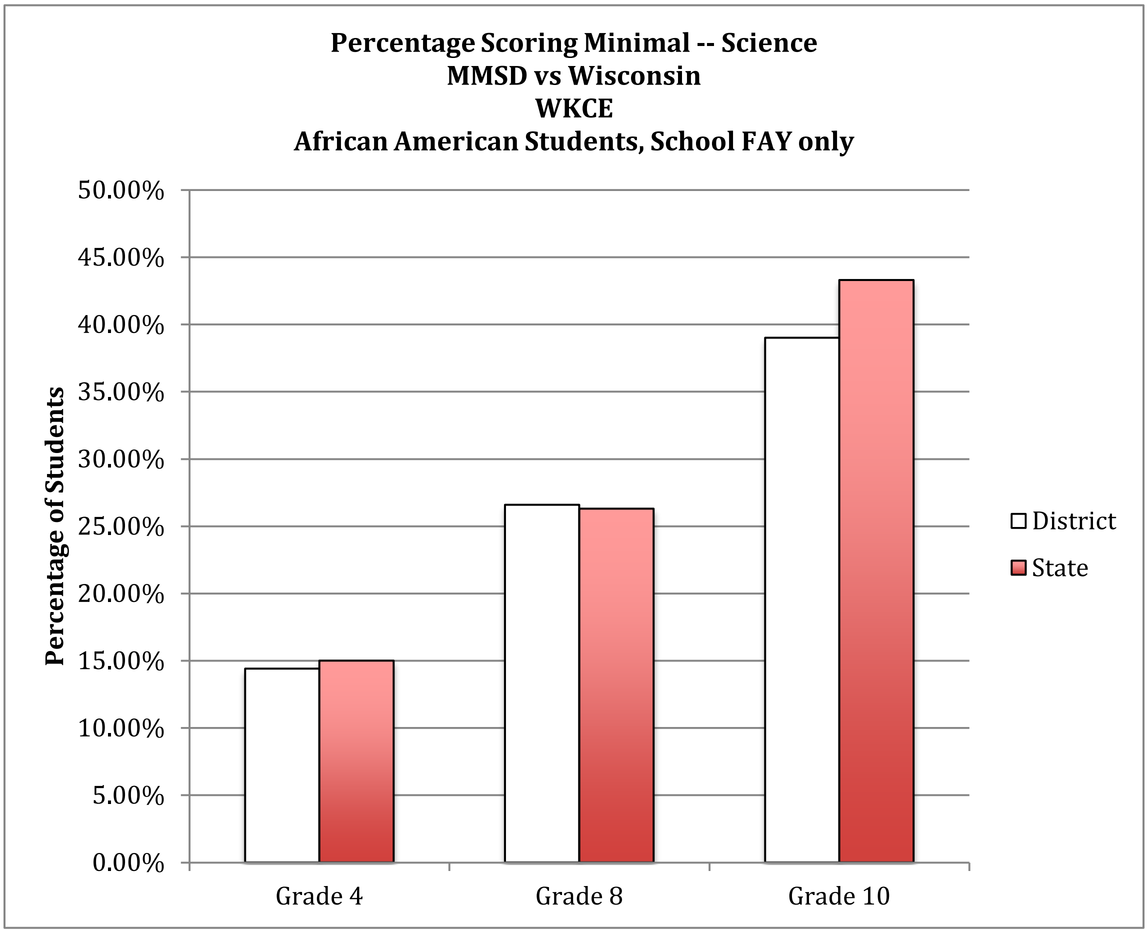


Source: DPI's WINSS site for 2010-2011 school year

African American Students

For all grades tested, percentage of minimal scores at the district level ranges from lower to higher than the state average on the 2010 WKCE. This range lies between four points lower to one point higher than the state average.

MMSD follows the same trend as the state. This means that nearly four of ten African American students are only achieving at the minimal level in 10th grade.

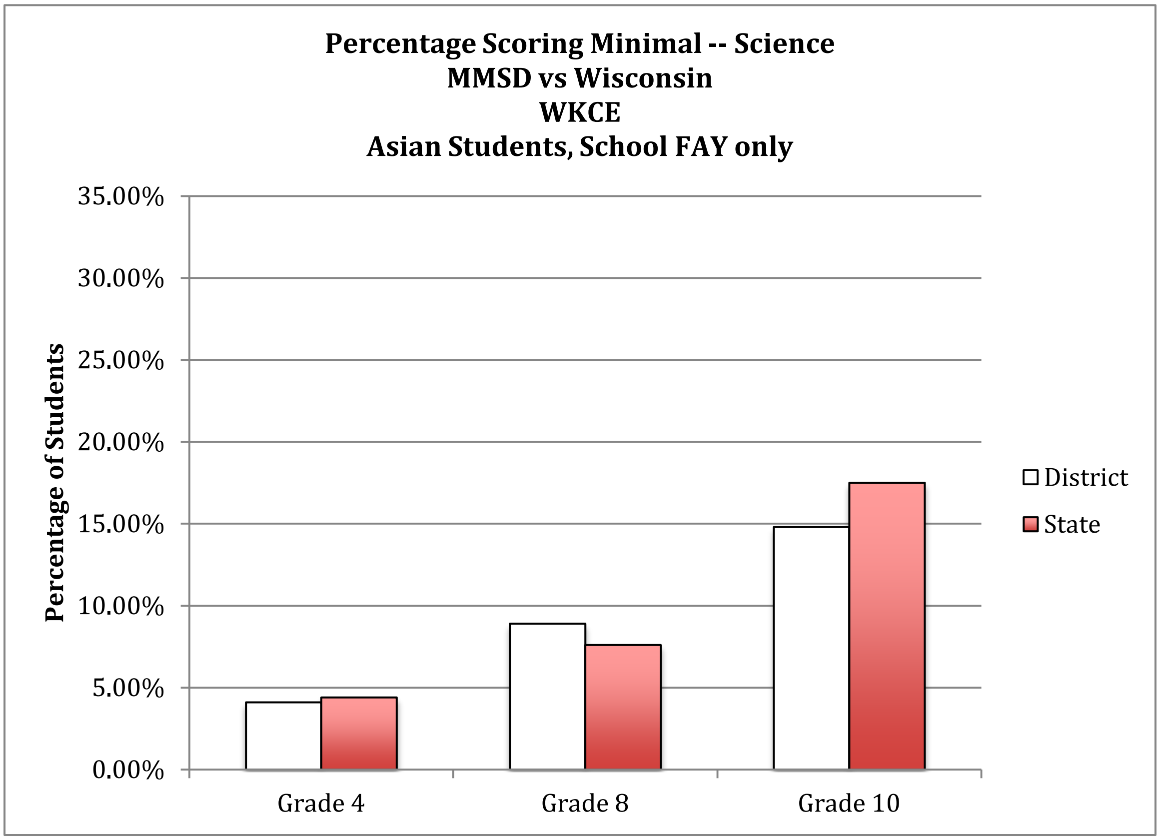


Source: DPI's WINSS site for 2010-2011 school year

Asian Students

For all grades tested, percentage of minimal scores at the district level ranges from lower to higher than the state average on the 2010 WKCE. This range lies between three points lower to one point higher than the state average.

MMSD's trend mirrors the state trend, with 8^{th} grade having a larger jump than the state level.

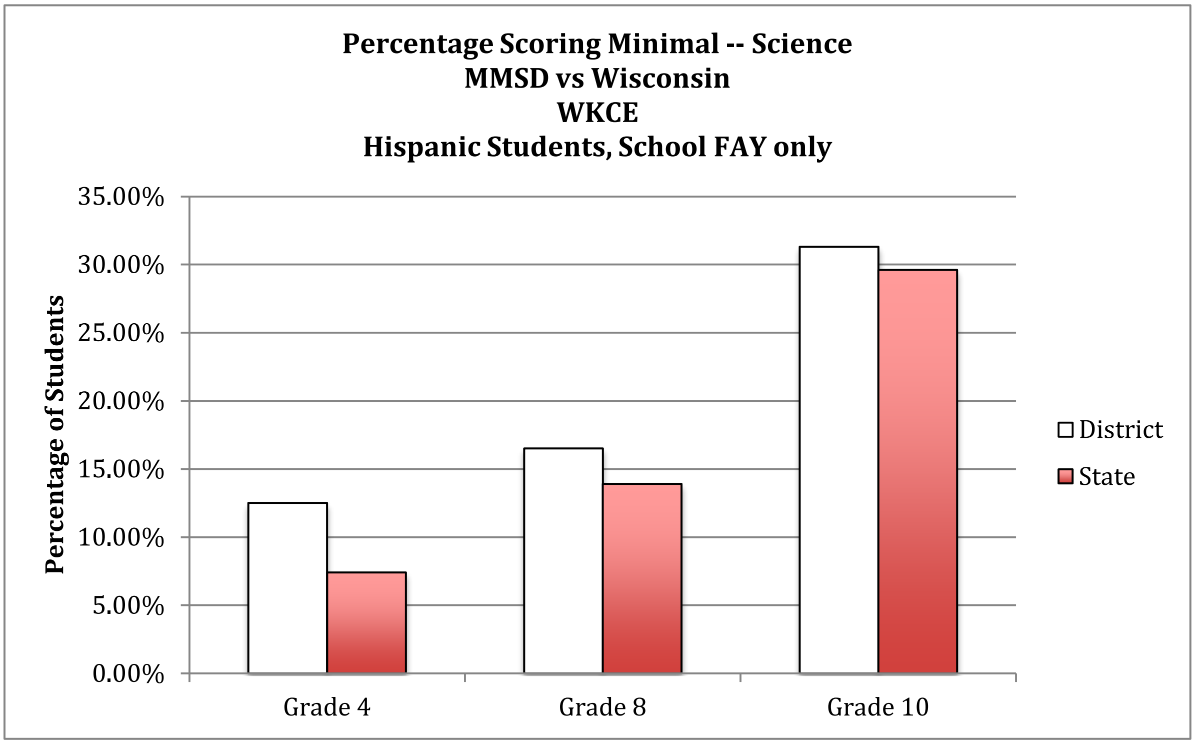


Source: DPI's WINSS site for 2010-2011 school year

Hispanic Students

For all grades tested, percentage of minimal scores at the district level ranks higher than the state average on the 2010 WKCE. This range lies between three to five points higher than the state average.

While the MMSD trend matches that of the state, MMSD has many more students at the minimal level than the state. This culminates in 10th grade with nearly one of three Hispanic students being at the minimal level on the WKCE.

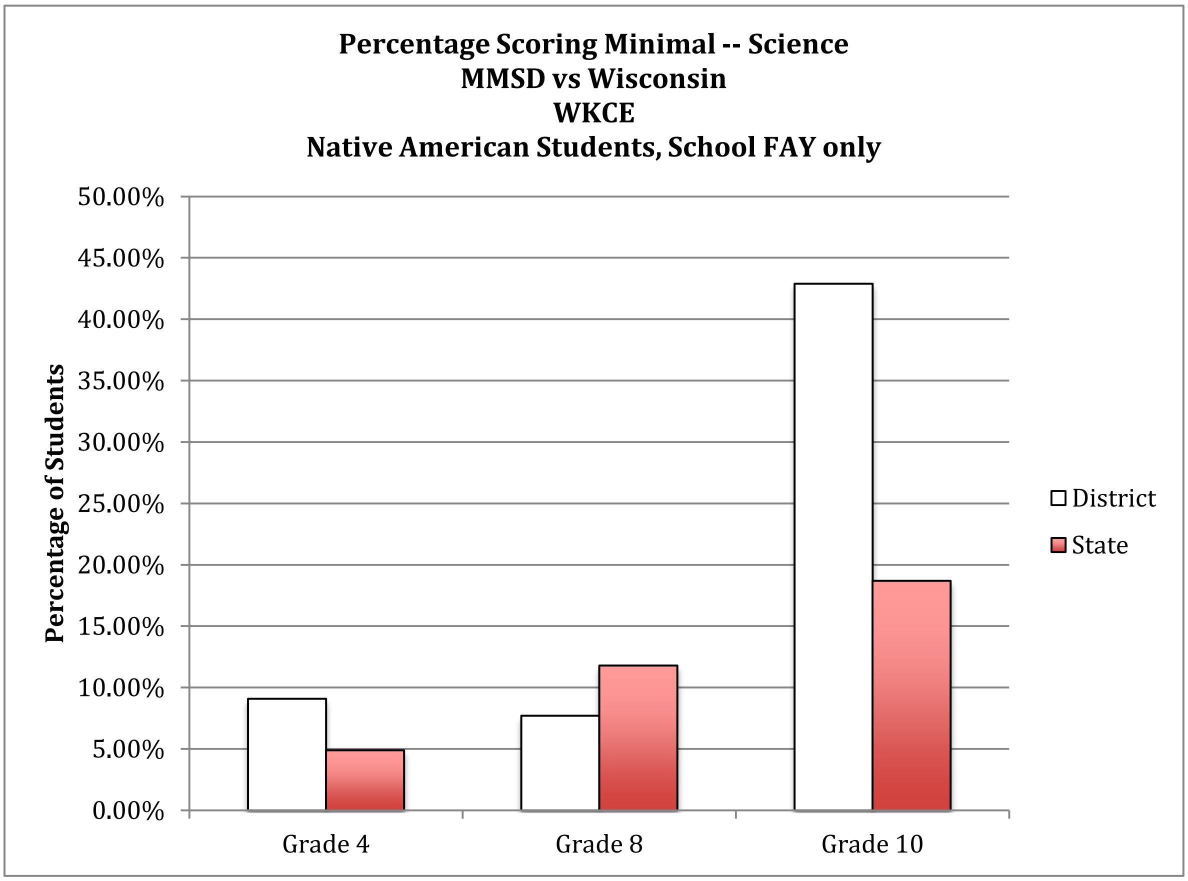


Source: DPI's WINSS site for 2010-2011 school year

Native American Students

For all grades tested, percentage of minimal scores at the district level ranges from lower to higher than the state average on the 2010 WKCE. This range lies between three points lower to 24 points higher than the state average.

MMSD does not follow the trend of the state. At 10th grade, more than four of ten students are at minimal proficiency. The number of students included in this data is very small, thus one student score can greatly influence the data. This may be the case in 2010, as the previous two years scores are nearly the same as the state average.

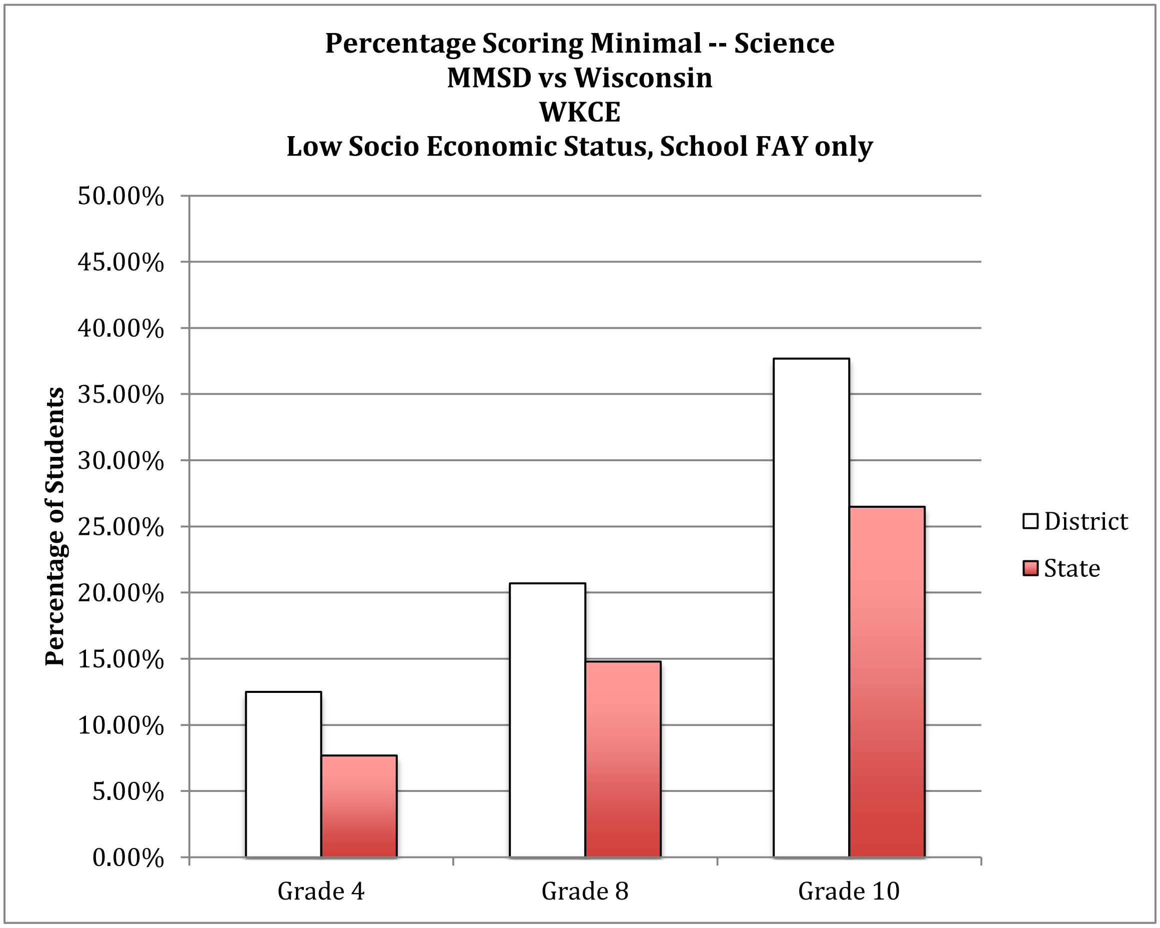


Source: DPI's WINSS site for 2010-2011 school year

Socio-Economic Status Students

For all grades tested, percentage of minimal scores at the district level ranks higher than the state average on the 2010 WKCE. This range lies between five to 11 points higher than the state average.

MMSD follows the state trend, however at a higher rate than the state. By 10th grade, one out of three MMSD students with low socio-economic status are at the minimal level of the WKCE.

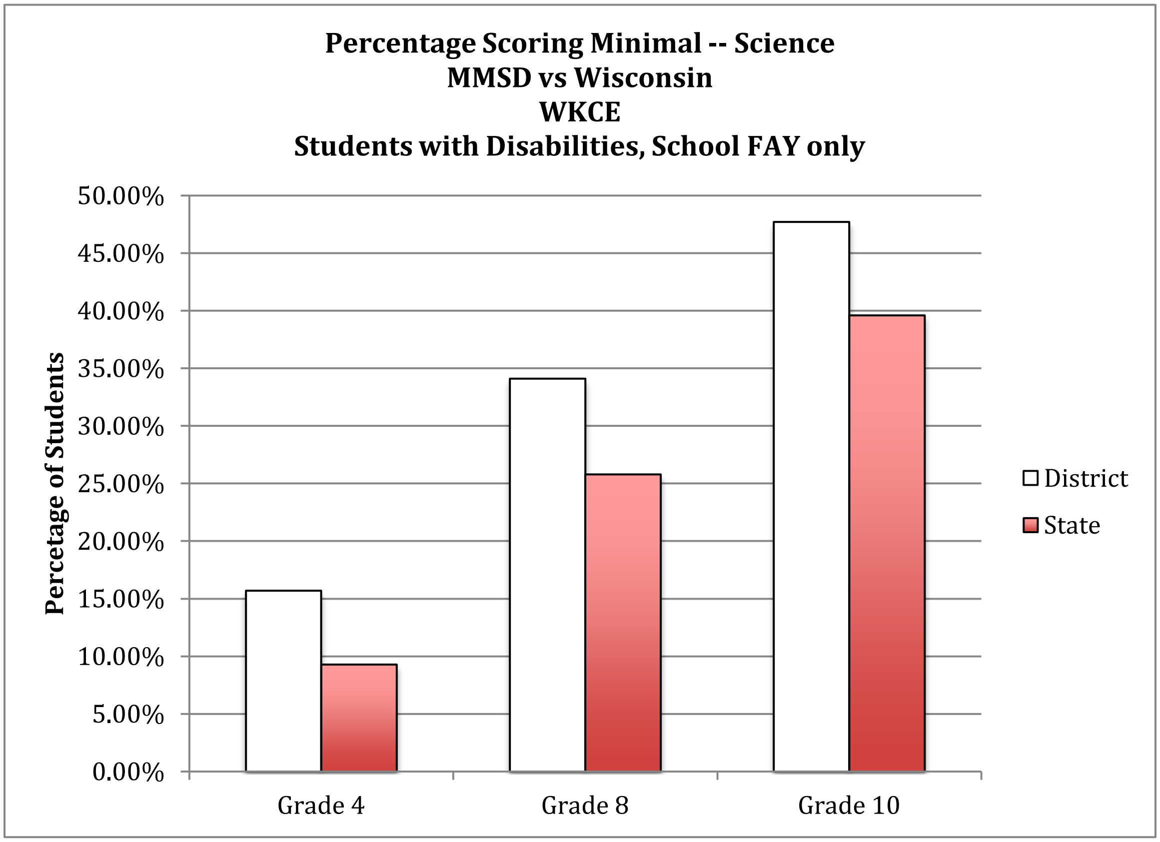


Source: DPI's WINSS site for 2010-2011 school year

Students with Disabilities

For all grades tested, percentage of minimal scores at the district level ranks higher than the state average on the 2010 WKCE. This range lies between six to nine points higher than the state average.

MMSD follows the state trend, however at a higher rate than the state. By 10th grade, one out of two MMSD students with disabilities are at the minimal level of the WKCE.



Source: DPI's WINSS site for 2010-2011 school year

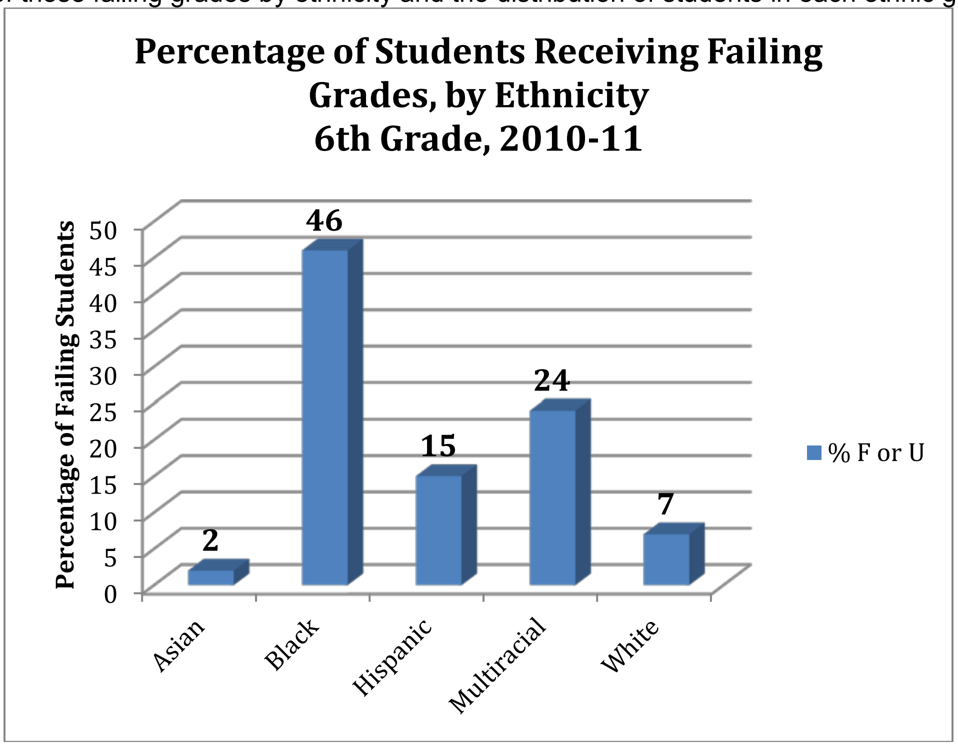
Course Failure Data, Middle School

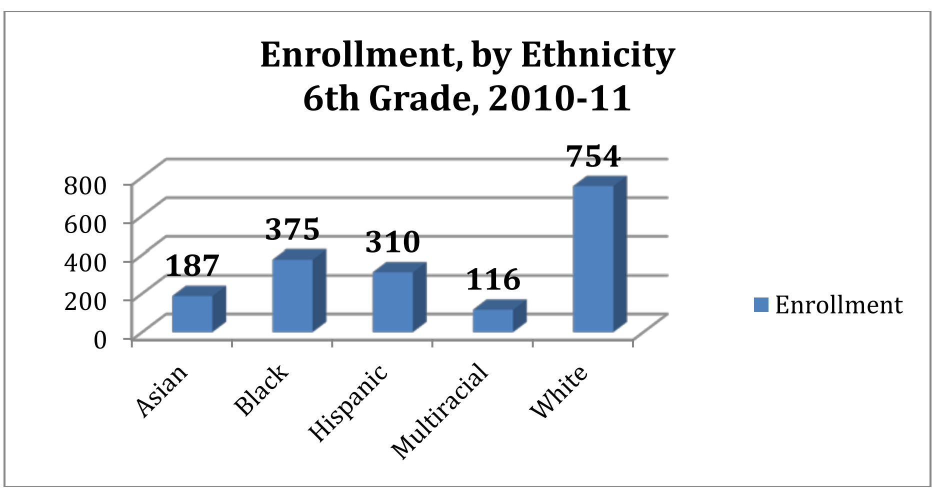
Transition years have been shown to be critical to students learning. Academic success in science in 6th and 9th grades help provide a strong start in Middle School and High School careers.

Student grades for the 2010-2011 school year were evaluated for failing (F) or unsatisfactory (U) grades in any quarter. This data does not include summer school or for alternative programming. This was not reported for small ethnic groups.

In Middle Schools during the 2010-2011 school year, there were 1749 6th grade students taking science classes. Of those, 101 received an "F" or a "U" during at least 1 quarter. This represents 6% of the total number of students.

Of those 6% of all Middle School students failing at least 1 quarter, the tables below shows the distribution of those failing grades by ethnicity and the distribution of students in each ethnic group.





MMSD data

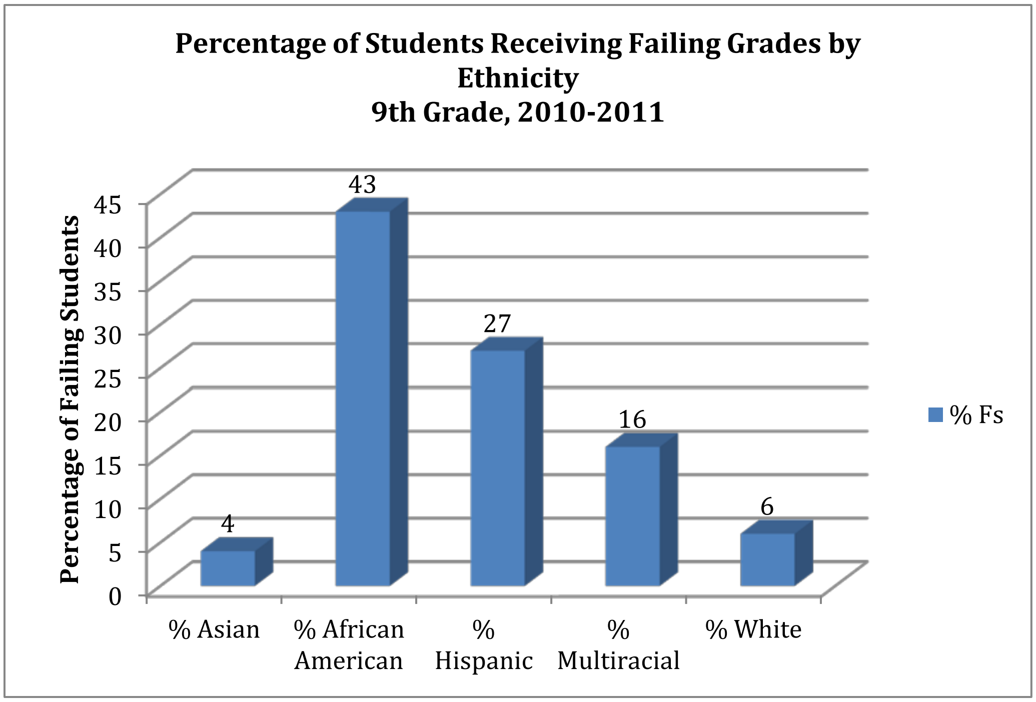
Course Failure Data, High School

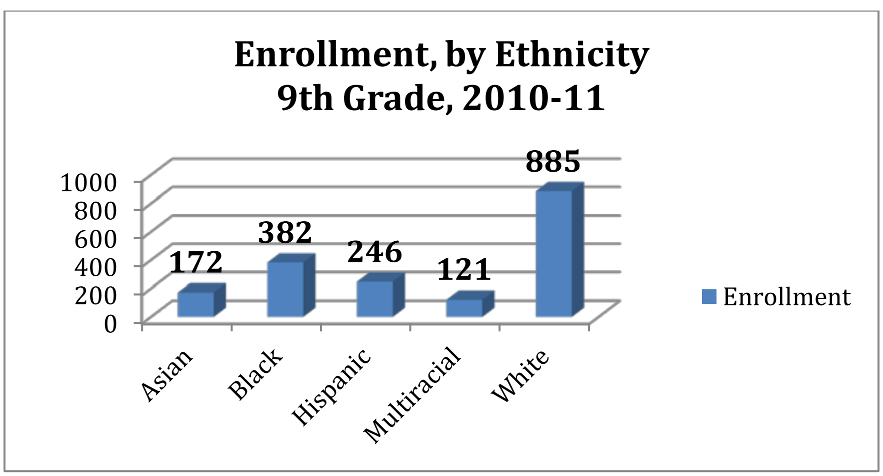
In High Schools during the 2010-2011 school year, there were 3339 9th grade students taking science classes (this may include a single student taking *more than one* science course). Of those, 382 received an “F” during at least 1 quarter. This represents 11% of the total number of students.

Of those 11% of all High School students failing at least 1 quarter, the first table below shows the distribution of those failing grades by ethnicity. The second table shows ethnic distribution in the 9th grade.

African American students represented a disproportionally high percentage of those 382 students with an “F” grade. This is nearly one out of two failing grades in high school science being earned by African American students.

Hispanic students were also at a high level, with over 1 out of 4 failing grades being earned by Hispanic students.





MMSD data

Instructional Practices Survey and Findings

Purpose and Design

A basic premise of curricular review and evaluation rests on determine how well the current curricula are working. However, the correlation of district curricula with student achievement data is much more complex. A valid review of curricular programs to improve student learning requires detailed analysis of three aspects of curriculum: written curriculum, taught curriculum, and assessed curriculum. These three aspects must not be assumed to be the same. It is a faulty assumption to conclude that materials and programs considered "district" curriculum are the materials and practices that are used to actually teach students. It is further a faulty assumption to conclude that the assessment tools employed district-wide are providing evidence of what the district curriculum details.

An electronic survey was created and administered to gather information on the instructional curricula and practices of all K-12 MMSD teachers involved in science instruction. This survey was designed to gather information directly to more accurately describe the curricula and practices actually used in our classrooms at all levels.

A national search was undertaken to locate exemplar survey tools for possible use. Because no single tool was specific enough to meet the particular needs of this survey, elements from several survey instruments were combined, in addition to the create of specific questions that focused on the science materials of MMSD.

Administration

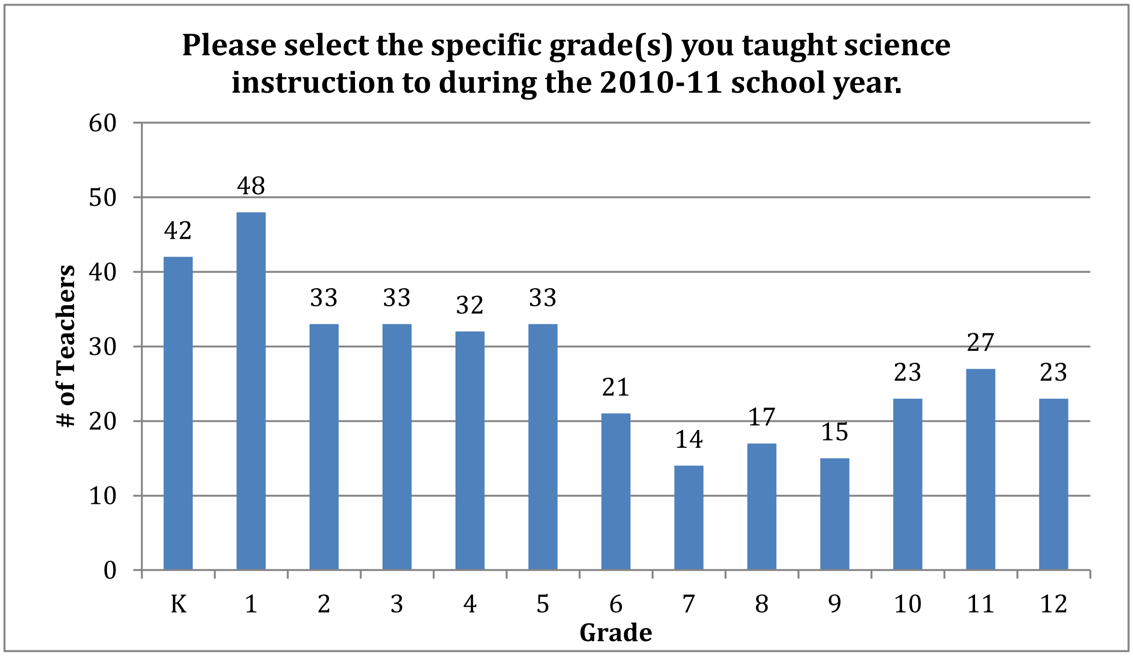
The final survey contained 30 questions (several had multiple sub-components). Not all questions were required of all teachers as some were specific to grade levels taught. The survey was estimated to take approximately 10 minutes to complete. Principals were requested to support stuff in completing the survey. Participating in the survey was voluntary and results are confidential.

The resulting survey tool was administered electronically via Zoomerang to all instructional staff in November, 2011 (see appendix A) Instructional staff included all classroom teachers and certified support staff with instructional responsibilities. The percent return rate by level follows: elementary, 23%; middle, 52%; and high, 60%.

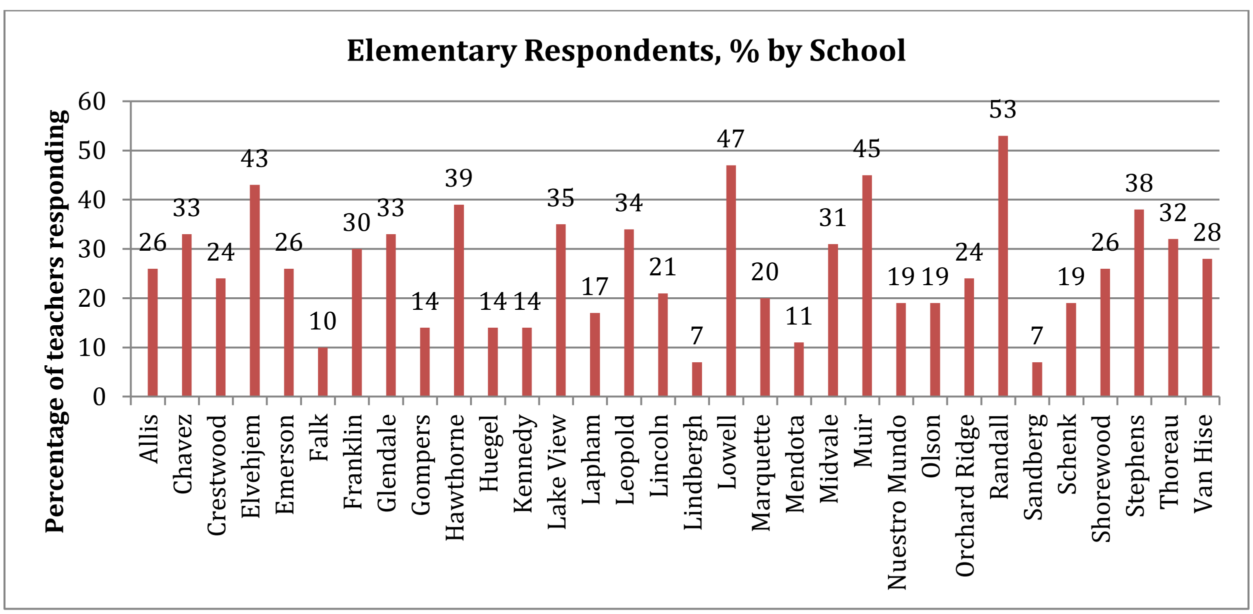
Findings

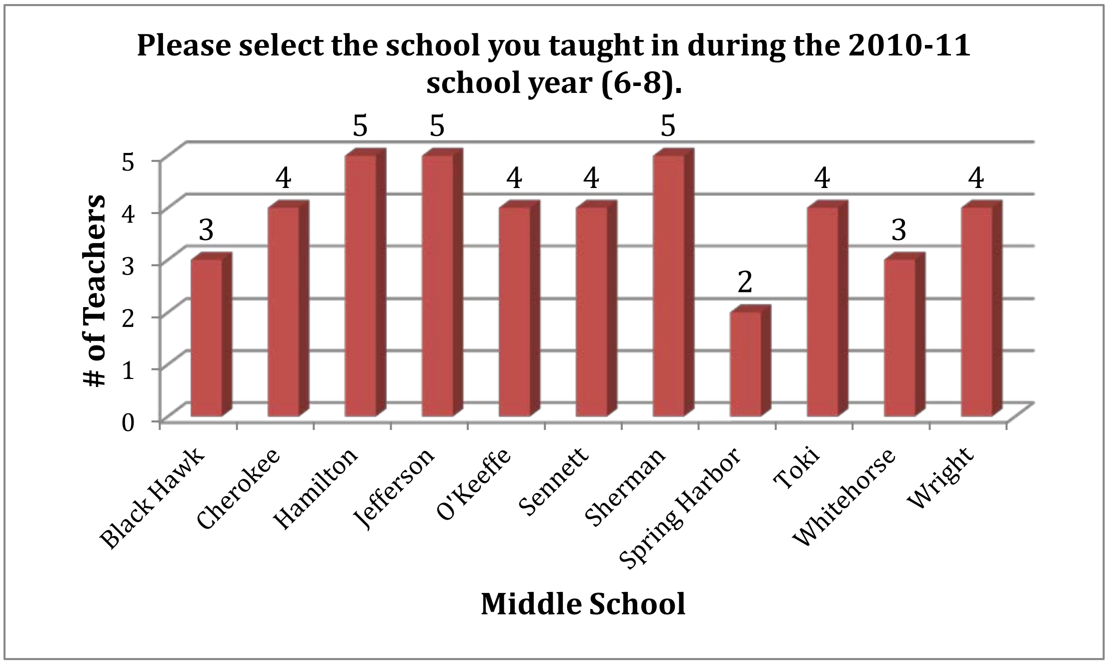
Who took the survey?

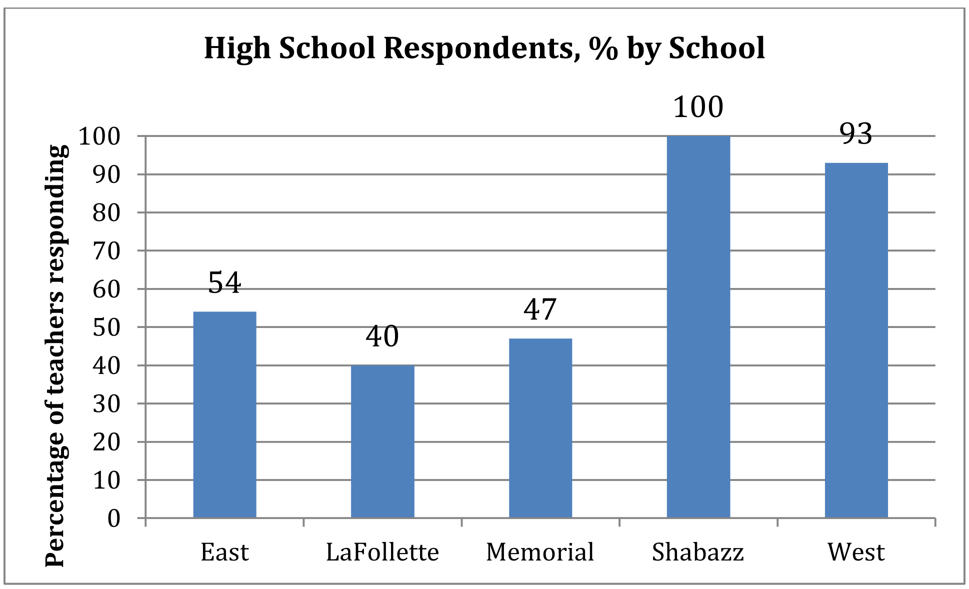
While teachers from all grade levels took the survey, proportionally the Middle and High School teachers responded in higher numbers than Elementary.



Which schools are represented by the survey?



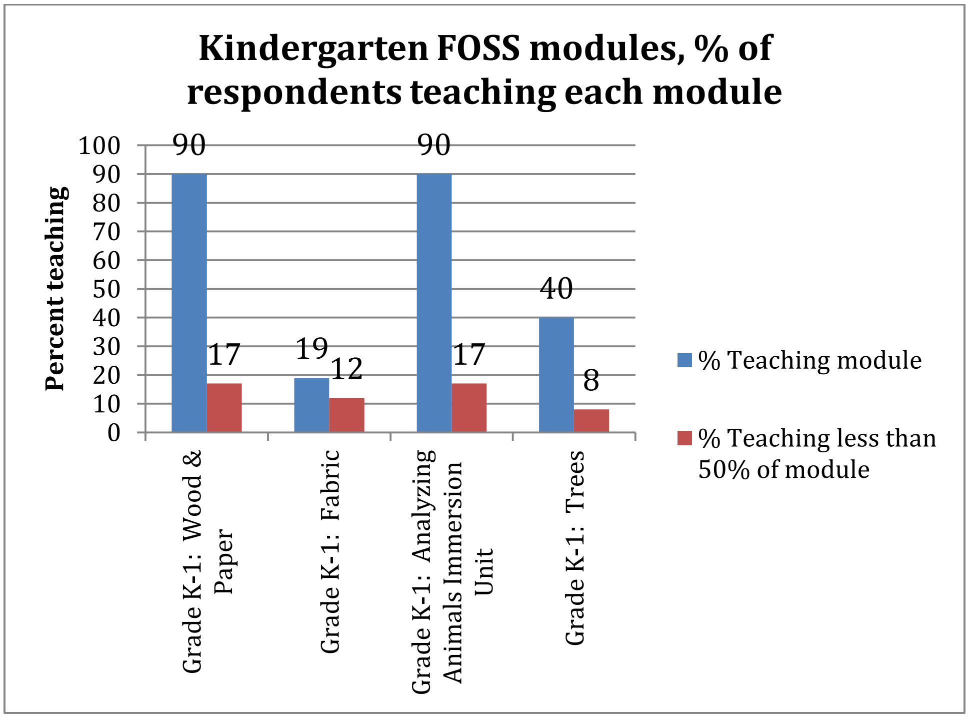




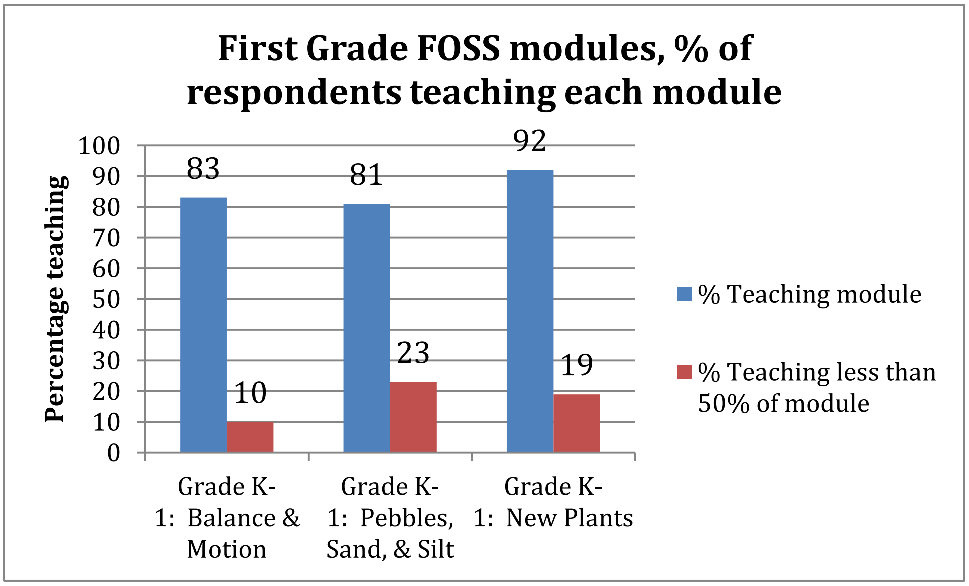
Survey takers, Middle School (top) and High School (bottom).

What content are teachers teaching?

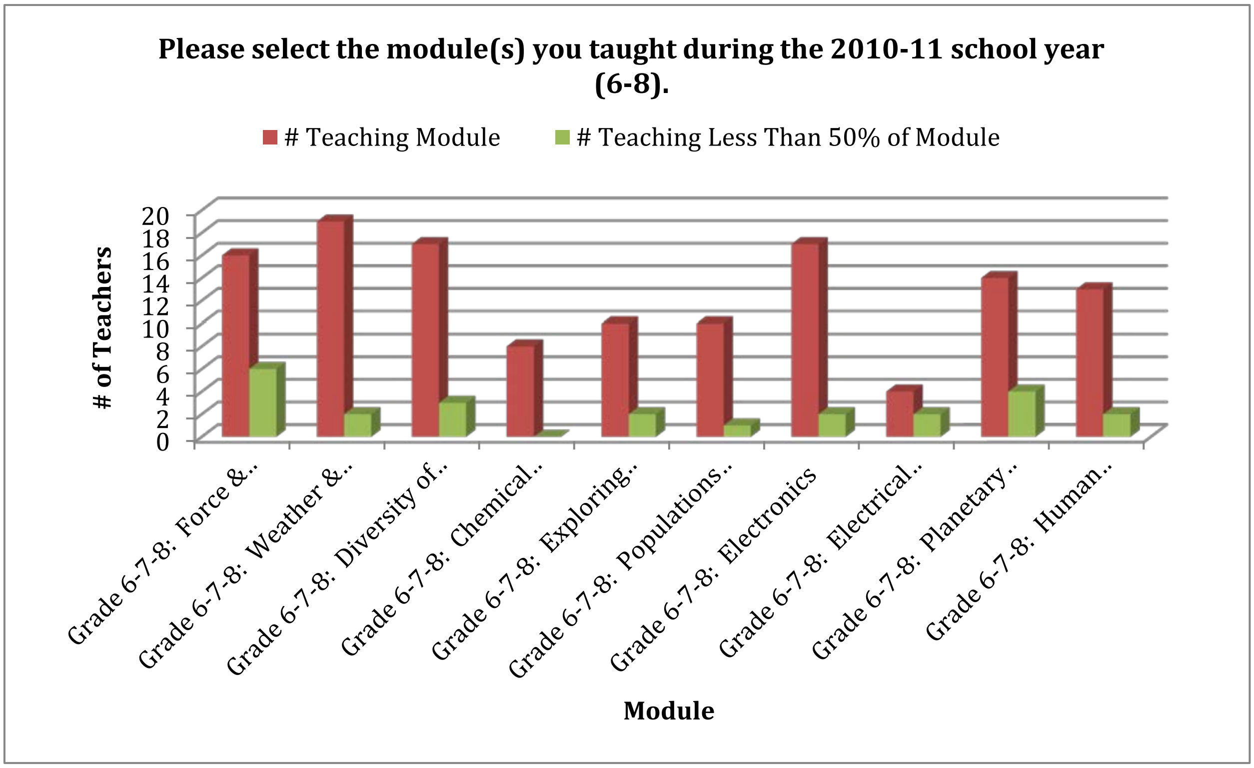
In elementary schools, multiple teachers teach each module at each grade level. This is different than at middle and high schools, were a teacher usually is a content area expert (or at least is able to teach fewer subjects and share this expertise across several classrooms). Percentages do not equal 100%, due to multiaged classroom data included.



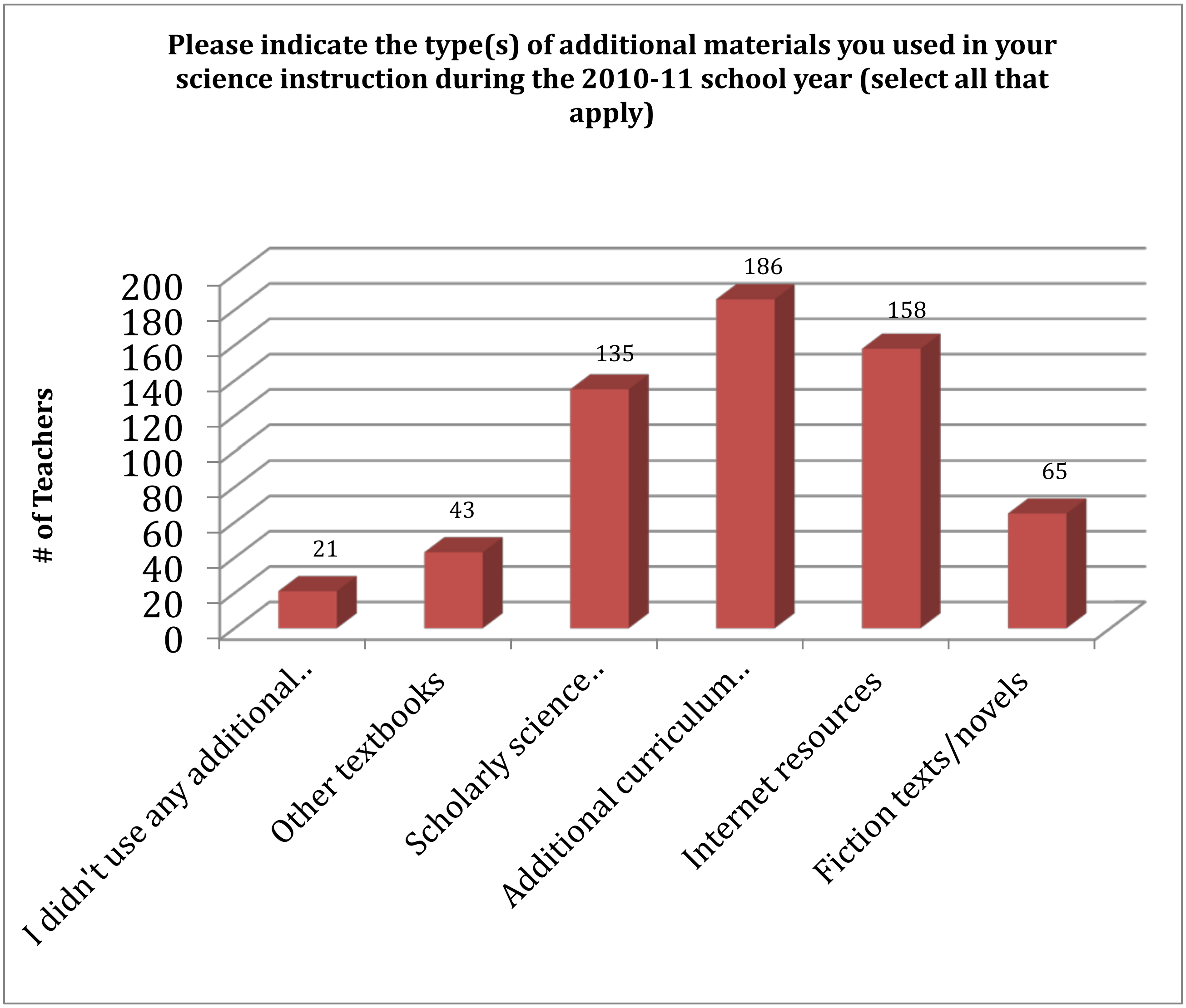
Both the FOSS Fabric and Trees modules are <u>optional</u> at the Kindergarten level.



In the middle schools, teachers tend to become more content "experts" than in elementary school. This would account for the smaller number of staff teaching less than 50% of a FOSS module.



The graph below shows the types of additional material, if any, are used by teachers to suppliment the core classroom materials. The vast majority of respondants supplimented the core material with additional curricular material, with internet resources following closely.



The following tables show what the statisitical significance is of teacher responses to a series of questions about their practice in the science classroom. Results of note are as follows:

- More high school teachers rely on the national science standards, while elementary and middle school teachers tend to use district standards more often.
- The use of pre-testing and summative assessments in the science classroom is greater at the high school level than at the elementary and middle school. However, the use of formative assessment is greatest at the middle school.
- High school students are asked to formally present their data and to argue in support of their results more than students at earlier grades.
- Elementary teachers are likely to engage students in flexible groups, work in whole group settings, and do demonstrations within the classroom.
- Elementary teachers are much more likely to include outdoor learning opportunites into the science experience.
- Elementary teachers are significantly more likely to use outside resourses, such as the School Forest, the Cherokee Marsh, and the Planetarium, that are teachers at the middle and high school levels.
- Middle and High school teachers report that they are much more likely to collaborate with other teachers in the building around science instruction.
- Middle and High school teachers are significantly more likely to have taken specific science professional development or course work than are elementary teachers.

Science Instructional Practice Survey - Q22 to Q25
Were there significant differences between instructional levels?

	Level			
	1-Elementary (n=146)	2-Middle (n=43)	3-High (n=34)	
	Avg Response 1-5	Avg Response 1-5	Avg Response 1-5	Significant Difference Between Levels?
Question 22: How often do you reference and use the following? (Likert Scale 1-5, 1 = Never, 5 = All or Most)				
National Science Education Standards?	1.83_{a}	2.57_{b}	2.55_{b}	Yes
WI Model Academic Standards (K-12)	2.36_{a}	3.02_{b}	$2.68_{a,b}$	Yes
MMSD Standards (K-8)	3.41_{a}	3.72_{a}	1.48_{b}	Yes
Question 23: In your science instruction, how often do you: (Likert Scale 1-5, 1 = Never, 5 = All or Most)				
Pretest your students at the beginning of each new unit	1.87_{a}	2.61_{b}	$2.25_{a,b}$	Yes
Use formative assessments	3.33_{a}	4.24_{b}	4.00_{b}	Yes
Use summative assessments	3.07_{a}	3.95_{b}	4.28_{b}	Yes
Use student data to make changes in your instructional program	3.92_{a}	4.05_{a}	4.18_{a}	No
Question 24: How often do students engage in the following practices in your classroom? (Likert Scale 1-5, 1 = Never, 5 = All or Most)				
Ask questions	4.78_{a}	4.76_{a}	4.82_{a}	No
Develop and use models	3.56_{a}	3.57_{a}	3.94_{a}	No
Plan and carry out investigations	3.87_{a}	3.69_{a}	3.59_{a}	No
Interpret and analyze data	3.89_{a}	3.93_{a}	3.94_{a}	No
Use mathematics, information & computer technology,and computational thinking	3.57_{a}	3.60_{a}	3.85_{a}	No
Construct explanations	4.05_{a}	4.26_{a}	4.26_{a}	No
Engage in argument from evidence	3.15_{a}	$3.55_{a,b}$	3.82_{b}	Yes
Communicate information formally	3.35_{a}	$3.48_{a,b}$	3.82_{b}	Yes
Question 25: Within your classroom practices for science instruction, how often do you allow for the following:(Likert Scale 1-5, 1 = Never, 5 = All or Most)				
Individual work	3.65_{a}	4.05_{b}	$3.97_{a,b}$	Yes
Small group work	4.19_{a}	4.26_{a}	4.21_{a}	No
Flexible grouping	4.01_{a}	3.57_{b}	$3.67_{a,b}$	Yes
Whole group work	4.06_{a}	$3.90_{a,b}$	3.64_{b}	Yes
Demonstrations	4.05_{a}	3.76_{b}	3.62_{b}	Yes
Discussions	4.33_{a}	4.10_{a}	4.35_{a}	No
Formal presentations	2.90_{a}	3.10_{a}	3.26_{a}	No

Science Instructional Practice Survey - Q27 to Q30
Were there significant differences between instructional levels?

	Level			
	1-Elementary (n=146)	2-Middle (n=43)	3-High (n=34)	
	Avg Response 1-5	Avg Response 1-5	Avg Response 1-5	Significant Difference Between Levels?
Question 27: Within your classroom practices for science instruction, how often do you: (Likert Scale 1-5, 1 = Never, 5 = All or Most)				
Ask higher order thinking questions (open ended)	4.11_a	$4.39_{a,b}$	4.45_b	Yes
Allow students to work at their own pace	3.90_a	3.74_a	3.58_a	No
Make connections between science and other disciplines	4.11_a	4.31_a	4.09_a	No
Provide different amounts of time for students to complete the same task	4.04_a	4.02_a	3.70_a	No
Connect academic content to students' cultural heritage, current events, or daily lives	3.80_a	3.50_a	3.69_a	No
Connect academic content to outdoor learning environments	3.65_a	3.31_a	2.69_b	Yes
Question 26: Do you access any of the following locations in addition to your classroom for science instruction? Percent Responding Yes				
School Forest	$70\%_a$	$46\%_b$	$7\%_c$	Yes
Cherokee Marsh	$31\%_a$	$8\%_b$	$7\%_b$	Yes
Planetarium	$62\%_a$	$42\%_{a,b}$	$20\%_b$	Yes
City Parks	$47\%_a$	$35\%_a$	$27\%_a$	No
Question 29: In regards to teaching science, do you ever: (Percent Responding Yes)				
Collaborate with an instructional team around science and/or student work in science (ELL, Sped, SES, AVID, Literacy coach, etc.)?	$.78\%_a$	$88\%_a$	$87\%_a$	No
Collaborate with school leadership teams around science and/or student work in science?	$.16\%_a$	$63\%_b$	$58\%_b$	Yes
Question 30: In the past 3 years, have you:				
Taken formal courses in science/science teaching?	$23\%_a$	$71\%_b$	$81\%_b$	Yes
Attended or led PD/conferences/workshops for science?	$.3\%_a$	$76\%_b$	$73\%_b$	Yes
Received any local, state, or national grants or awards for science teaching?	$8\%_a$	$12\%_a$	$9\%_a$	No
Served in a science leadership position?	$17\%_a$	$19\%_a$	$21\%_a$	No

The Science Materials Center

The Science Materials Center (SMC) is designed to support science education in grades K-8 across the district. Data was collected regarding the use of the SMC during the 2011-2012 school year. This year should be considered "atypical" as there was a late transition in the SMC Technician position and living material was not going out to schools. Normally, this is not the case. The data was collected from the order data save in the Scope and Sequence Science Materials Ordering program, an online ordering system for teachers.

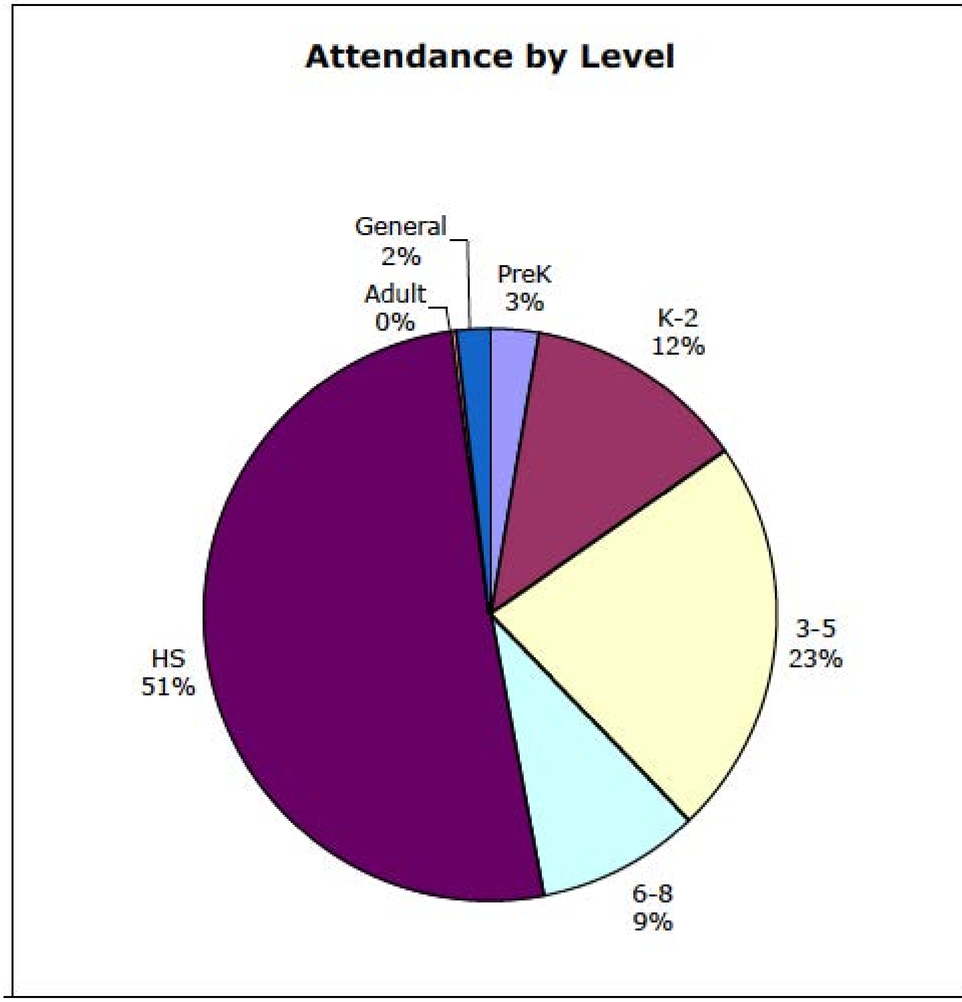
School	Classrooms	Live orders (number of items or sets)	Consumable orders (number of items or sets)	Total items or sets ordered	Total items or sets/ classroom
Kennedy	29	5	110	115	3.97
Leopold	29	19	181	200	6.9
Chavez	27	16	203	219	8.11
Schenk	27	0	82	82	3.04
Crestwood	25	5	62	67	2.68
Thoreau	25	1	74	75	3
Allis	23	2	95	97	4.22
Elvehjem	23	9	97	106	4.61
Huegel	22	11	200	211	9.59
Muir	22	2	28	30	1.36
Olson	21	0	85	85	4.05
Stephens	21	3	65	68	3.24
Falk	20	12	58	70	3.5
Franklin	20	7	57	64	3.2
Emerson	19	6	60	66	3.47
Lowell	19	6	22	28	1.47
Shorewood	19	7	40	47	2.47
Hawthorne	18	9	24	33	1.83
Mendota	18	18	68	86	4.78
Van Hise	18	4	176	180	10
Lake View	17	0	31	31	1.82
Orchard Ridge	17	7	55	62	3.65
Nuestro Mundo	16	2	26	28	1.75
Glendale	15	6	52	58	3.87
Lindergh	15	2	11	13	0.87
Randall	15	1	101	102	6.8
Sandburg	15	0	161	161	10.73
Gompers	14	3	22	25	1.79
Lincoln	14	9	96	105	7.5
Midvale	13	9	156	165	12.69
Lapham	12	2	18	20	1.67
Marquette	10	2	68	70	7

From this data, we see a wide variety of ordering trends. While some schools order very little, others heavily use the support from the SMC. Since this data was collected, many more schools are ordering materials, including those that traditionally order very little. This is due in large part to successfully recommitting to "customer service" after the transition in SMC personnel.

It is interesting to note that, in general, smaller elementary schools use more material per classroom than larger elementary schools.

The Planetarium

The Planetarium, located within James Madison Memorial High School, provides astronomy education for both MMSD students and for the public. Attendance for the 2010-11 school year was 19,889 people, divided into the following levels.



Value-added Science Data

The Wisconsin Center for Education Research (WCER) and the Value Added Research Center (VARC) have worked with MMSD to more deeply understand the Science data resulting from the WKCE.

VARC uses data over time to determine what factors actually make a difference in student academic achievement. The following two tables have been created to specifically look at the MMSD Science program.

The first table looks at 4th grade WKCE scores, and factors that may effect student performance when compared to the mean (average) WKCE scale score in science. The "scale score" represents the number of points scored on the exam, not the proficiency level. Proficiency levels are determined at the state level and identified by "cut scores" – specific scale scores that represent cut off points between proficiency levels. Each of the characteristics below are compared to their "non" counterpart: female vs non-female, black vs non-black, etc.

The table below can be read in the following way: if you are a female 4th grade student in MMSD science, you are likely to score 2.89 point below the mean scale score when compared to a male student (the "non-female" student).

These coefficients are also additive; having mulitple characteristics will combine the coefficients. For example, a 4th grade female who has an identified learning disability would have the following coefficient: (-2.89) + 12.86 = 9.97. This means that this student would likely score 9.97 points higher on the WKCE Science scale score than a student who does not have these characteristics.

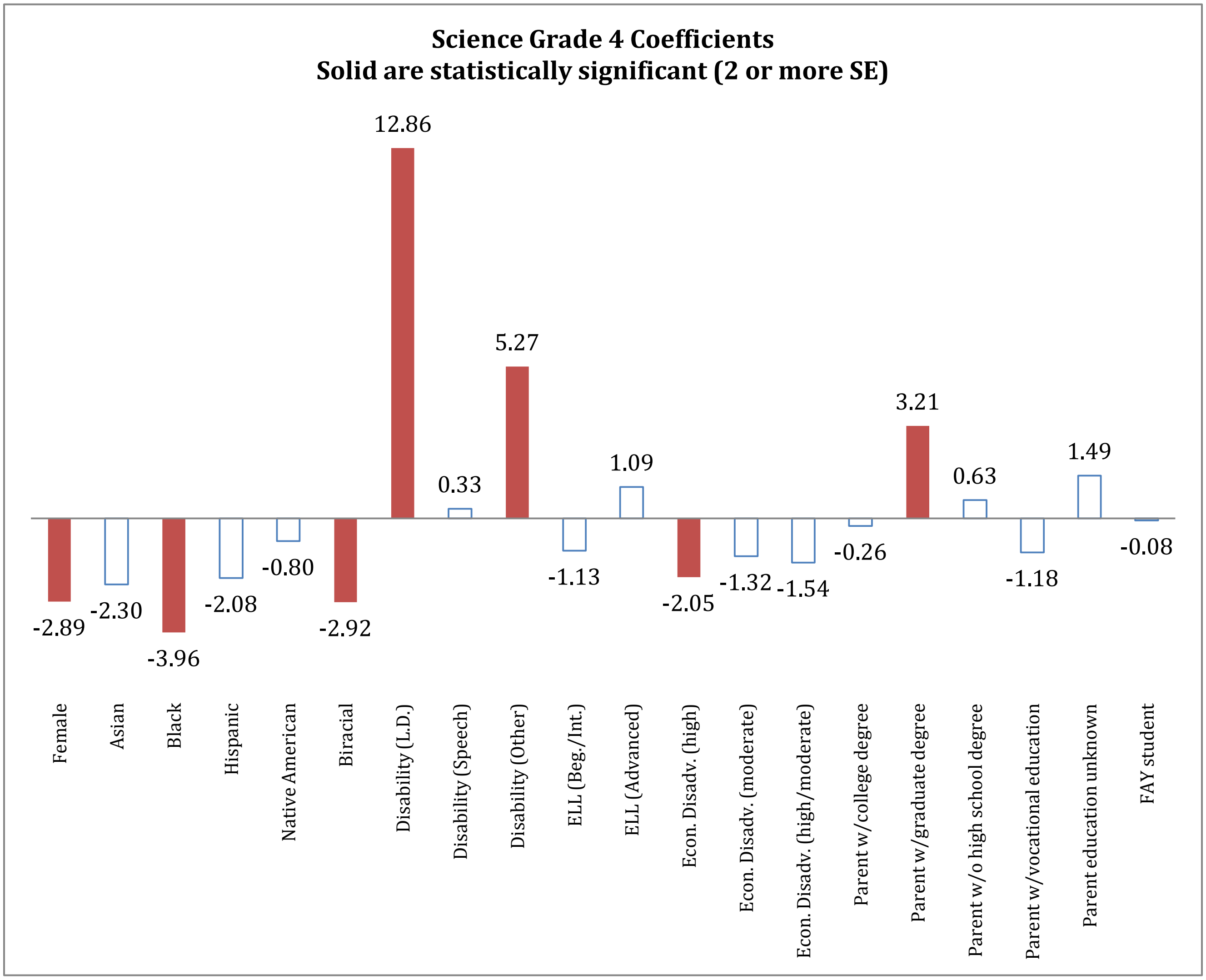


Table 1

Note: The solid lines represent items that have statistically significance.

The second VARC table looks at 8th grade WKCE scores, and factors that may effect student performance when compared to the mean (average) WKCE scale score in science. This can be read in the following way: if you are a female 4th grade student in MMSD science, you are likely to score 8.15 point below the mean scale score when compared to a male student.

Again, these coefficients are also additive; having mulitple characteristics will combine the coefficients. For example, a 8th grade male who has parents with a graduate degree would have the following coefficient: (0) + 6.36 = 6.36. This means that this student would likely score 6.36 points higher on the WKCE Science scale score than a student who does not have these characteristics. The (0) represents that there is no coefficient for being male, only for being female.

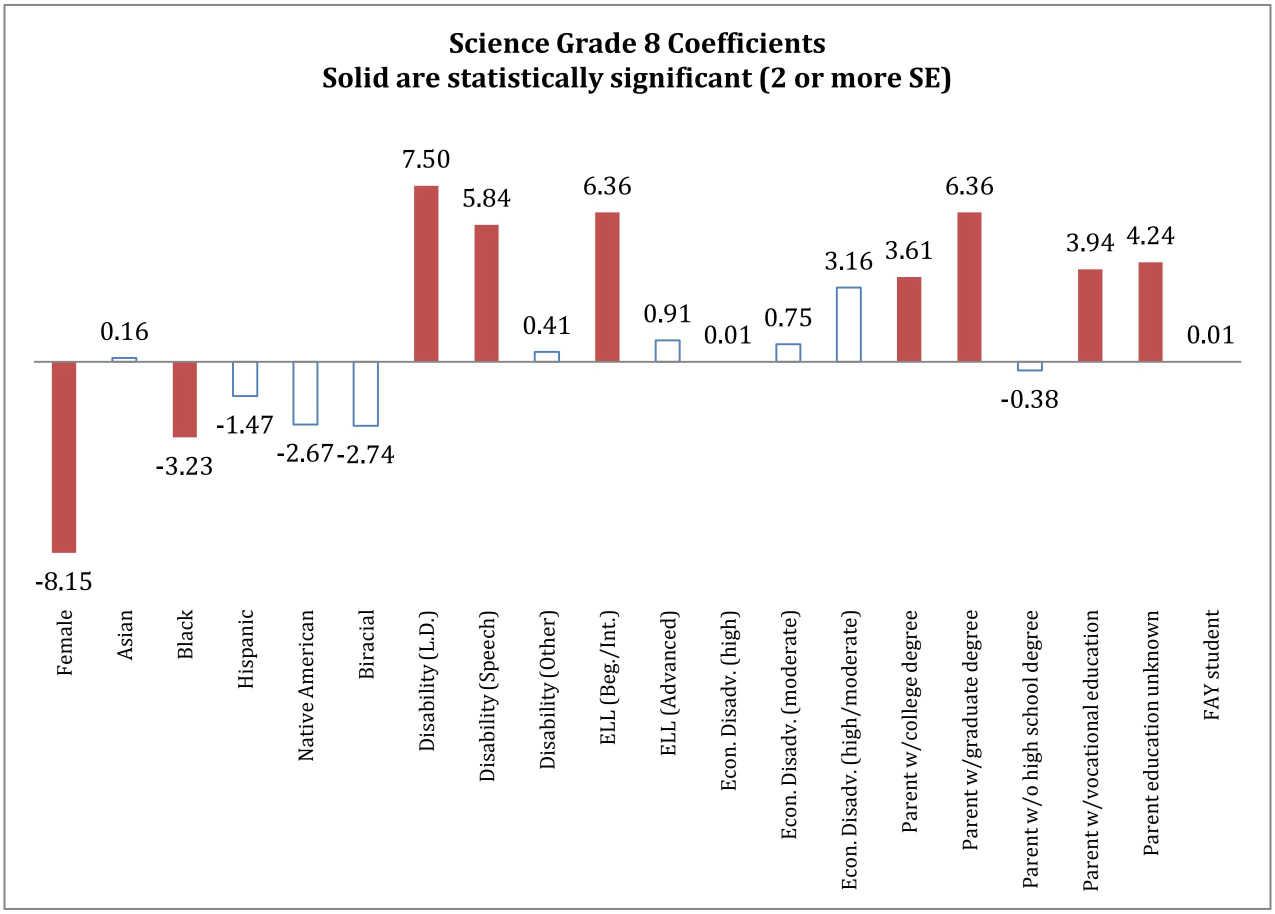


Table 2

Note: The solid lines represent items that have statistically significance.

The National Assessment of Educational Progress

The National Assessment of Educational Progress, or NAEP, is a national assessment designed to determine how students are doing on a national level. Since the United States does not have a national test as many countries do, the NAEP is the closest measure to such a test.

While the NAEP originally was used to help measure US progress when compared to other countries, it's purpose has changed since the implementation of the No Child Left Behind legislation. One of the current uses of the NAEP, other than to support the international comparison, is to determine the strength of state standardized assessments. Wisconsin's Knowledge and Concepts Examination has been shown to be an inadequate assessment when compared to the NAEP.

The data shown below helps to place the above MMSD data into context. From the data provided above, it is difficult to determine if MMSD students are performing below, at, or above the national average on standardized testing in Science.

The NAEP test does not return results specifically at the school or district level, rather at the state level. This means that the MMSD comparison to the nation as a whole requires a two-step process: district to state, then state to nation.

Grade 4

In figure 1 below, a comparison of state results at grade 4 is shown. It indicates that students in a majority of states (in orange) perform at a lower level than Wisconsin students. Students in 12 states score roughly at the same level, while students in 8 states score higher than students in Wisconsin.

Figure 2 shows that Wisconsin 4th graders scored 8 points higher than the national average, while figure 3 indicates that 42% of Wisconsin 4th graders earned "proficient" or "advanced" scores on the NAEP. This same graph indicates that 21% of Wisconsin 4th graders where in the lowest category, Basic.

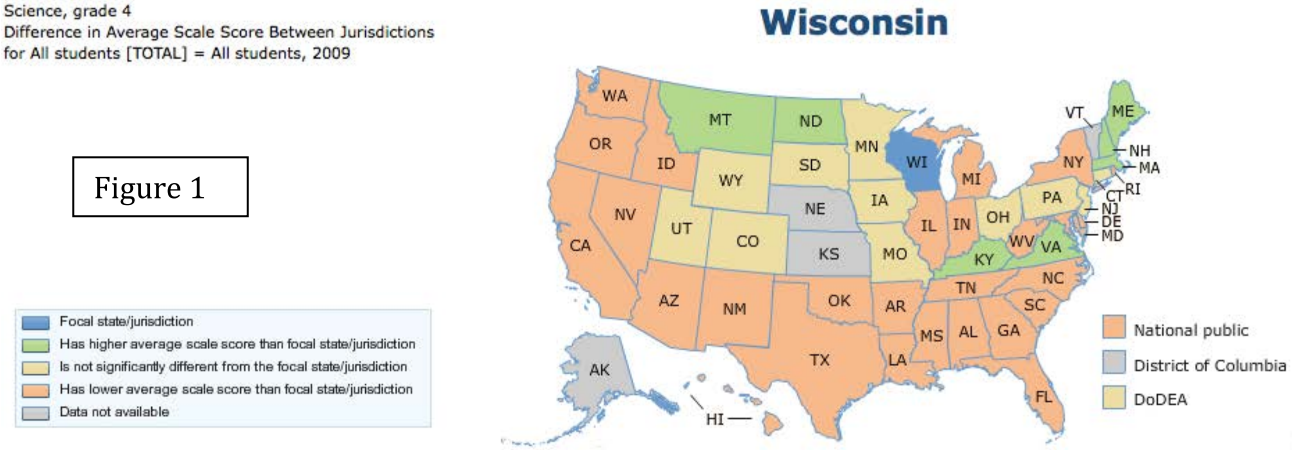
Grade 8

Similar to grade 4, Wisconsin 8th graders score higher than students in more than half of the states (figure 4). Wisconsin students scored at level not statistically different than students in 15 states. Finally, 5 states scored higher than Wisconsin 8th graders.

Also like Wisconsin 4th graders, our 8th grade students scored 8 points higher than the national average. Figure 3 shows that 39% of 8th grade students scored "proficient" or "advanced" on the NAEP. This same graph shows that 27% of these same students scored in the "basic" (lowest) category.

Science, grade 4
Difference in Average Scale Score Between Jurisdictions
for All students [TOTAL] = All students, 2009

Figure 1



NOTE: Reported differences are statistically significant at the .05 level. DoDEA=Department of Defense Education Activity (overseas and domestic schools).
SOURCE: U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics, National Assessment of Educational Progress (NAEP), 2009 Science Assessment.

Average scale scores for science, overall science scale, grade 4, by year and jurisdiction for
All students [TOTAL]: 2009
All students

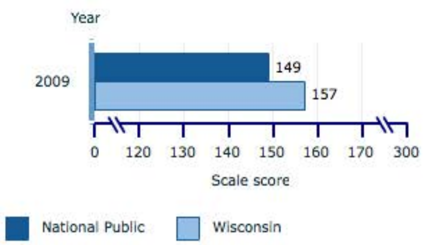


Figure 2

NOTE: The NAEP Science scale ranges from 0 to 300. Some apparent differences between estimates may not be statistically significant.
SOURCE: U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics, National Assessment of Educational Progress (NAEP), 2009 Science Assessment.

Percentages at or above each achievement level for science, overall science scale, grade 4, by year for jurisdiction and All students [TOTAL]: 2009
Wisconsin, All students

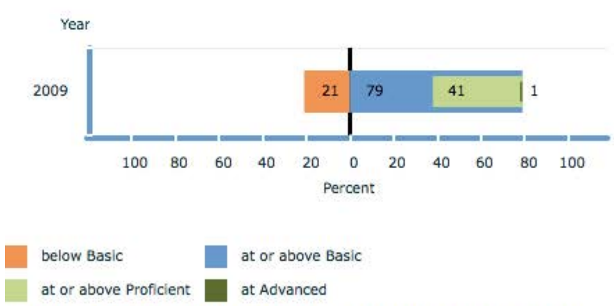


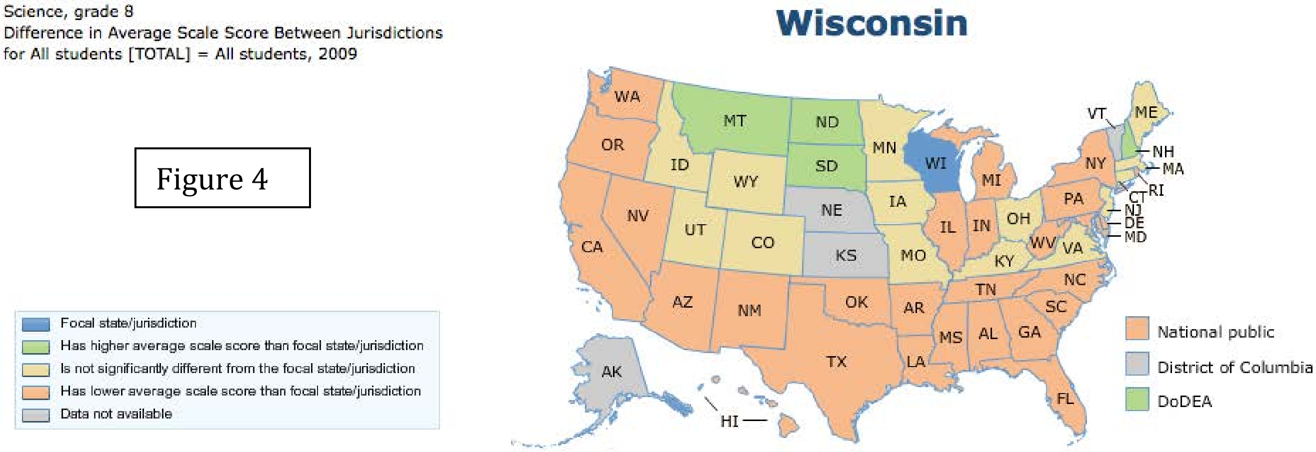
Figure 3

NOTE: The NAEP Science scale ranges from 0 to 300. Some apparent differences between estimates may not be statistically significant.
SOURCE: U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics, National Assessment of Educational Progress (NAEP), 2009 Science Assessment.

NAEP Grade 4 Science 2009 Data

Science, grade 8
Difference in Average Scale Score Between Jurisdictions
for All students [TOTAL] = All students, 2009

Figure 4



NOTE: Reported differences are statistically significant at the .05 level. DoDEA=Department of Defense Education Activity (overseas and domestic schools).
SOURCE: U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics, National Assessment of Educational Progress (NAEP), 2009 Science Assessment.

Average scale scores for science, overall science scale, grade 8, by year and jurisdiction for
All students [TOTAL]: 2009
All students

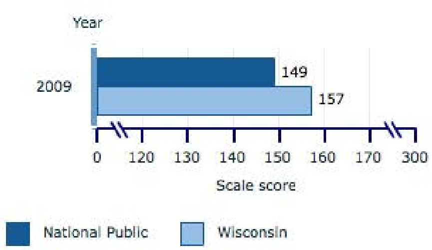
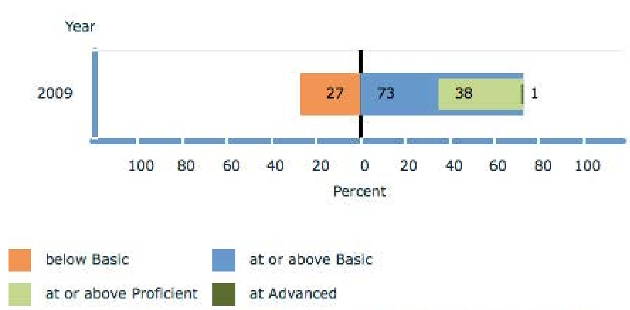


Figure 5

NOTE: The NAEP Science scale ranges from 0 to 300. Some apparent differences between estimates may not be statistically significant.
SOURCE: U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics, National Assessment of Educational Progress (NAEP), 2009 Science Assessment.

Percentages at or above each achievement level for science, overall science scale, grade 8, by year for jurisdiction and All students [TOTAL]: 2009
Wisconsin, All students



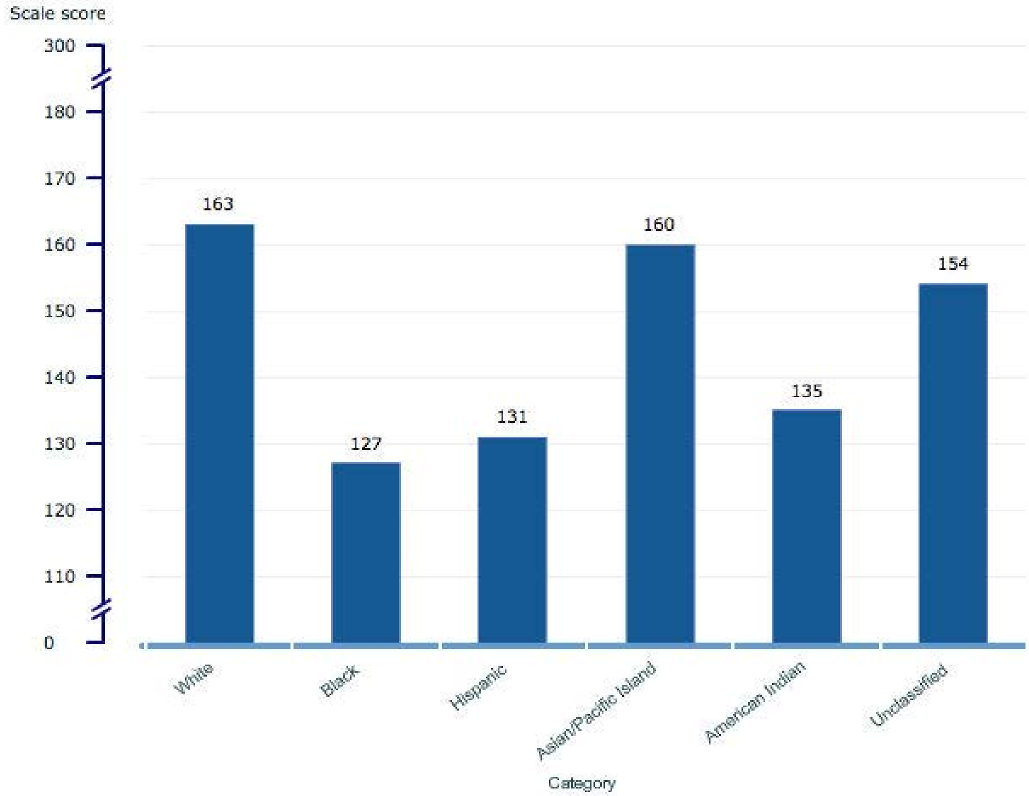
NOTE: The NAEP Science scale ranges from 0 to 300. Some apparent differences between estimates may not be statistically significant.
SOURCE: U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics, National Assessment of Educational Progress (NAEP), 2009 Science Assessment.

Figure 6

NAEP Grade 8 Science 2009 Data

Grade 4 NAEP Science Scores by Ethnicity

Average scale scores for science, grade 4 by race/ethnicity used to report trends, school-reported for year and jurisdiction: 2009
2009, National

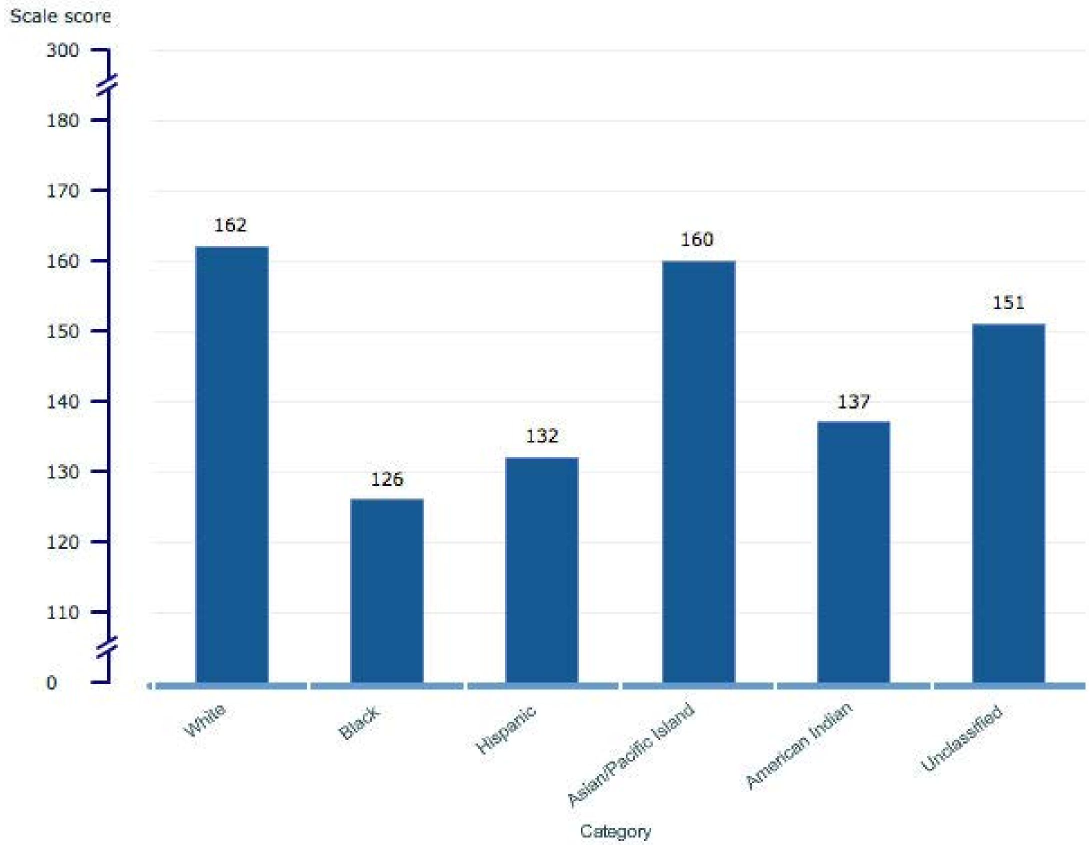


NOTE: Black includes African American, Hispanic includes Latino, Pacific Islander includes Native Hawaiian, and American Indian includes Alaska Native. Race categories exclude Hispanic origin unless specified. The NAEP Science scale ranges from 0 to 300. Some apparent differences between estimates may not be statistically significant.
SOURCE: U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics, National Assessment of Educational Progress (NAEP), 2009 Science Assessment.

This NAEP data shows that there is a large gap in achievement between ethnic groups. Both White and Asian/Pacific Island students scored much higher than Black, Hispanic, or American Indian students.

Grade 8 NAEP Science Scores by Ethnicity

Average scale scores for science, grade 8 by race/ethnicity used to report trends, school-reported for year and jurisdiction: 2009
2009, National



NOTE: Black includes African American, Hispanic includes Latino, Pacific Islander includes Native Hawaiian, and American Indian includes Alaska Native. Race categories exclude Hispanic origin unless specified. The NAEP Science scale ranges from 0 to 300. Some apparent differences between estimates may not be statistically significant.
SOURCE: U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics, National Assessment of Educational Progress (NAEP), 2009 Science Assessment.

The NAEP data for ethnicities is nearly the same at 8th grade as it is at 4th grade. Both of these data sets generally represent the situation in MMSD.

Chapter 6

K-12 Science Program and Practice Description

This chapter provides a view into what the current science programs and practices are in the Madison Metropolitan School District. Each level, elementary, middle, and high school, will be described below. These descriptions are based on the both the staff survey that was conducted and the general knowledge of the members of the Science Program Evaluation Advisory Committee.

Elementary Science (K-5)

Curriculum

The district currently supports the Full Option Science System (FOSS) curriculum by Lawrence Hall of Science. It was adopted in 1997 and became the supported curriculum across the district in 2002. This curriculum was developed on the premise that students learn science best by doing science. This program was created to give students the opportunity to actively construct ideas through their own inquiries, investigations, and analyses. In doing so, students are able to gain an appreciation for scientific endeavors, learn important scientific concepts, and develop the ability to think constructively and create new ideas.

According to the survey conducted by the District Science Review Committee in November 2011, approximately 7 out of 10 of the MMSD elementary respondents covered more than 50% of the material in the FOSS modules they taught in the past year.

The FOSS program has three goals:

- **SCIENTIFIC LITERACY.** Provide students with science experiences that
  - are appropriate to their cognitive stages of development and
  - serve as a foundation for more advanced ideas that prepare them for life in an increasingly complex scientific and technological world
- **INSTRUCTIONAL EFFICIENCY.** Provide all teachers with a complete, flexible, easy-to-use science program that
  - reflects current research on learning, including collaborative learning, student discourse, and embedded assessment, and
  - buses effective instructional methodologies, including hand-son active learning, inquiry, integration of disciplines and content areas, and multi-sensory methods.
- **SYSTEMIC REFORM.** Meet the community science-achievement standards and societal expectations for the next generation of citizens, prepared with the knowledge and thinking capacities to manage the 21st century.

The FOSS program is correlated to human cognitive development. Activities are matched to the way students think at different times in their lives. The research that guides FOSS developers indicates that humans proceed systematically through a predictable sequence of stages of cognitive development, thus FOSS has aligned their investigations to guarantee that the cognitive demands on students are appropriate for their cognitive development. The horizontal nature of FOSS allows for the materials to be developmentally appropriate while providing in-depth exposure to subject matter via multiple experiences. In addition, through the spiral design, FOSS promotes knowledge to be built on in order to foster deeper understanding of science concepts.

The FOSS program uses several instructional practices to make science more efficient for teachers and more productive for students including: inquiry, hands-on active learning, multi-sensory methods, student-to-student interaction, discourse and reflective thinking, and reading and research. The FOSS program also includes tools to provide evidence of learning in the form of a fully integrated assessment component. Assessment within the FOSS modules includes formative and summative assessment such as informal teacher observation, teacher questioning, anecdotal notes, student interviews, student written work, performance-assessments tasks and summative tests. Each program contains the following components: a FOSS Teacher Guide, Equipment Kit, Teacher Preparation Videos, and FOSS Student Resources.

As part of the FOSS curriculum adoption, professional development centered around the curriculum was offered to all elementary teachers. Expert teachers from outside the district lead a one-week institute on curriculum implementation. In the following years as MMSD teachers became skilled teachers of FOSS, grade level professional development was lead by expert teachers from within the district.

Over the last 5 years, professional development to support FOSS has not taken place on a regular basis. As the district has experienced a large turnover in teachers, there are now many K-8 teachers who have never received FOSS professional development.

The suggested K-8 Science Scope and Sequence Content Strands and Curriculum for MMSD using the FOSS materials are summarized in the following chart:

CONTENT STRANDS & CURRICULUM

<table>
<tr><th></th><th>PHYSICAL</th><th>EARTH</th><th>LIFE</th></tr>
<tr><td>K</td><td colspan="2">Properties of Materials
FOSS Wood & Paper
FOSS Fabric (Optional)</td><td>Characteristics of Animals
Analyzing Animals Immersion unit
FOSS Trees (Optional)</td></tr>
<tr><td>1</td><td>Balance and Motion
FOSS Balance & Motion</td><td>Properties of Earth Materials
FOSS Pebbles, Sand & Silt</td><td>Characteristics and Life Cycles of Plants
FOSS New Plants</td></tr>
<tr><td>2</td><td>Properties of the States of Matter
FOSS Solids & Liquids</td><td>Properties of Air & Monitoring the Weather and Moon Phases
FOSS Air & Weather</td><td>Characteristics and Life Cycles of Insects
FOSS Insects with MMSD modifications</td></tr>
<tr><td>3</td><td>Properties of Sound
FOSS Physics of Sound</td><td>Investigating Earth Materials
FOSS Earth Materials</td><td>Structure and Responses of Organisms
Investigating Responses Immersion unit with FOSS Structures of Life</td></tr>
<tr><td>4</td><td>Connections between Magnetism and Electricity
FOSS Magnetism & Electricity</td><td>Properties of Water
FOSS Water</td><td>Structures of Microscopic Organisms
STC Microworlds</td></tr>
<tr><td>5</td><td>Physical and Chemical Changes
FOSS Mixtures & Solutions</td><td>Earth Surface Changes
FOSS Landforms with MMSD modifications</td><td>Relationships between Organisms and Their Environments
FOSS Environments with MMSD modifications

Nature of Science & Science Inquiry
Relationships between System Variables
FOSS Variables</td></tr>
<tr><td>6</td><td>Motions and Forces
FOSS Force & Motion</td><td>The Earth’s Atmosphere and Weather
FOSS Weather & Water</td><td>Characteristics and Diversity of Life
FOSS Diversity of Life with Investigating Diversity of Life Immersion unit</td></tr>
<tr><td>7</td><td>Particle Behavior during Physical and Chemical Changes
FOSS Chemical Interactions</td><td>Earth’s History
Exploring Earth’s Landforms Immersion unit with FOSS Earth History</td><td>Populations of Organisms and their Ecosystems
FOSS Populations & Ecosystems</td></tr>
<tr><td>8</td><td>Properties and Uses of Electrical Systems
FOSS Electronics
Electrical Alarm System Immersion unit (Optional)</td><td>Earth in the Solar System
FOSS Planetary Science</td><td>Structure and Function of the Human Brain and Senses
FOSS Human Brain & Senses</td></tr>
</table>

PROCESS SKILLS

	Scientific Processes and Thinking Skills
K	• Explore, identify, describe and compare properties of objects or characteristics of organisms • Make and record scientific observations • Investigate questions about objects or organisms using prior knowledge • Demonstrate, illustrate and communicate understandings using data
1	• Explore, identify, describe and compare properties of objects or characteristics of organisms • Use observations/data to describe and compare objects or organisms over time • Make and record scientific observations • Detect patterns in systems • Investigate questions about objects or organisms using prior knowledge • Demonstrate, illustrate and communicate understandings using data
2	• Explore, identify, describe and compare properties of objects or characteristics of organisms • Use observations/data to describe and compare objects or organisms over time • Make, record and graph scientific observations • Detect patterns in systems • Use scientific tools to measure change in living and nonliving systems • Plan investigations to answer questions • Demonstrate, illustrate and communicate understandings using data
3	• Explore, identify, describe and compare properties of matter and energy or characteristics of organisms • Use observations/data to describe and compare objects or organisms over time • Make, record and graph scientific observations • Detect patterns in systems • Use scientific tools to measure change in living and nonliving systems • Plan investigations to answer questions and make predictions • Demonstrate, illustrate and communicate understandings using data
4	• Explore, identify, describe and compare properties of matter and energy or characteristics of organisms • Use observations/data to describe and compare objects or organisms over time • Make, record and graph scientific observations • Detect patterns in systems and use those patterns to make predictions • Use scientific tools to measure change in living and nonliving systems • Plan multiple investigations to answer questions and detect relationships • Make generalizations and offer multiple ideas to explain phenomena • Demonstrate, illustrate and communicate understandings using data

	Scientific Processes and Thinking Skills
5	• Explore, identify, describe and compare properties of matter and energy or characteristics of organisms • Use observations/data to describe and compare objects or organisms over time • Make, record and graph scientific observations • Detect patterns in systems and use those patterns to make predictions • Use scientific tools to measure change in living and nonliving systems • Plan multiple trials of controlled experiments to answer questions and detect relationships between variables • Make generalizations and offer multiple ideas to explain phenomena • Demonstrate, illustrate and communicate understandings using data
6	• Develop a scientifically testable question • Plan an investigation based on a scientifically testable question • Use scientific tools and technology appropriately • Collect and organize data • Compare and contrast objects, sources of data or concepts • Quantify and represent data in various forms (e.g. graphs) • Interpret data to detect patterns • Select and use appropriate equations • Use data to describe phenomena or make predictions • Use conceptual understanding to explain phenomena or make predictions
7	• Develop a scientifically testable question • Plan an investigation based on a scientifically testable question • Use scientific tools and technology appropriately • Collect and organize data • Make inferences based on data • Compare and contrast objects, sources of data or concepts • Quantify and represent data in various forms (e.g. graphs) • Interpret data to detect patterns • Select and uses appropriate equations • Use data to describe phenomena or make predictions • Construct and defend conceptual models • Uses physical and conceptual models to explain phenomena or make predictions
8	• Develop a scientifically testable question • Plan an investigation based on a scientifically testable question • Use scientific tools and technology appropriately • Collect and organize data • Make inferences based on data • Compare and contrast objects, sources of data or concepts • Quantify and represent data in various forms (e.g. graphs) • Interpret data to detect patterns • Select and use appropriate equations • Use data to describe phenomena or make predictions • Construct and defend conceptual models • Use physical and conceptual models to explain phenomena or make predictions

Science Material Center

The Science Materials Center (SMC) plays a critical role in the implementation of elementary science in our district. It was created shortly after the district's adoption of FOSS and houses consumable replacement items as well as live organisms for use with the FOSS modules. The consumables and live organisms are delivered directly to the schools on a weekly basis. The SMC is staffed by a SMC Technician (35 hrs/wk during the school year and 15 hrs/wk in the summer). An online ordering system for the consumable replacement items and live organisms was instituted when the SMC was created. It was updated in 2005 when the MyMMSD system was introduced. This made the ordering of consumable materials, plants, and animals even easier. The primary advantage to teachers is that they now have the ability to order materials at home. Easy directions and a video clip are available to help take them step-by-step through the ordering process. It was found that 72% of the respondents to the District Science Program Evaluation Advisory Committee survey in 2011 used the science material center to facilitate their teaching of the curriculum.

Immersion Units

In an effort to continually improve the science learning experience for students, the district became involved in a nation-wide grant with several partners, including the UW-Madison and the Los Angeles Unified School District. This grant, the SCALE grant, funded many improvements in both science and mathematics instruction in the district.

One of the content improvements developed through the grant are called "Immersion Units". These units were developed to flow like FOSS units, but to improve and deepen the inquiry approach used for teaching and learning. Specific units in Kindergarten, 2nd grade, 3rd grade, and 5th grade were developed and implemented in MMSD. Immersion units were also developed and implemented at grades 6,7, and 8.

The Immersion units that were developed and implemented were based on the latest research and best practice during this period. The experience for students was designed to take them from questioning through investigating to sharing information with others. These steps through a process were based on The Inquiry Cycle, an iterative process designed to deepen student understanding of scientific problem solving.

Immersion units were also designed with a greater connection to local resources. The Landforms Immersion Unit, for example, uses the geography of Wisconsin to teach concepts of the changing landscape. In contrast, the similar FOSS module uses an approach that is appropriate at a national level: the land features discussed include the Grand Canyon, among others. This more local connection of the Immersion Unit makes brings the scientific concepts to life for students who may never leave the area. It is important to note, however, that in all cases, both the FOSS module and the Immersion Unit are designed to be taught together, playing off the strength of each other.

Involvement in National Pilots/content development

The Madison Metropolitan School District was an early adopter of the middle school level FOSS modules. As such, the district has been in a position to be involved at several levels with FOSS curriculum and the developers at the Lawrence Hall of Science on the University of California – Berkley campus. Teams of teachers have been involved in national level pilot implementations of specific modules. This experience allowed for MMSD to have direct input into final development of content in several FOSS modules. The direct connection with the curriculum designers and developers has produced an ability to have influence in the development of new and updated FOSS modules.

Assessing Science Knowledge (ASK) project

The Assessing Science Knowledge (ASK) from the Lawrence Hall of Science (LHS), University of California at Berkeley, was a four-year project, with a start date of April 2003. It was designed to define, field test, and validate effective assessment tools and techniques to be used by grade 3-6 classroom teachers to assess, guide, and confirm student learning in science. The assessments were conceptualized, developed, and refined using the Full Option Science System (FOSS) science-education program. Curriculum developers/researchers at LHS collaborated with eight national test centers, one being in Madison, Wisconsin, comprising hundreds of teachers and thousands of students, and assessment researchers from the University of California at Berkeley Graduate School of Education and SRI International to validate new classroom assessments based on National Science Education Standards and AAAS Benchmarks. Guided by a synthesis of current cognitive theory and measurement principles, the assessment tools, procedures, and item banks developed by ASK would provide valid and fair inferences about student achievement, and have the potential to affect the design and implementation of all research-based elementary science programs.

MMSD offers Extended Learning Summer School with the purpose of remediation, enrichment, extended school year (ESY), retention, K-Ready, Play and Learn, and high school credit recovery. The ELSS is critical to closing the achievement gap and preparing all students for the 21st Century. Research tells us that over 50% of the achievement gap between lower and higher income students is directly related to unequal learning opportunities over the summer (Alexander et al., 2007). Extended learning summer school (ELSS) is a valuable time for students to receive extra practice and learning in academic areas for remediation or to receive enrichment opportunities. Several of these opportunities have a science focus.

Middle School Science (6-8)

The district currently uses a combination of FOSS modules and Immersion Units for middle school science instruction. As students move through the grades, they begin to experience teachers who teach only one or two content areas, unlike the elementary program. This increasing content expertise in the middle school setting allows teachers to become more deeply immersed in understanding student learning progressions and misconceptions.

The middle school curriculum extends from the base built in elementary schools. Specific titles of modules/units can be found above in the table entitled “Content Strands & Curriculum”. In many respects, the path of middle school science echoes that of elementary: there have been national pilots and content development, and professional development upon district adoption and implementation.

A significant difference is in the focus of continuing professional development. The Mathematics and Science Partnership (Title II B) grant funding that has been awarded to the district in the last six years has been substantial. This money has been used to focus directly on middle school science teachers and their content knowledge. The two grants are described below.

Science Masters Institute (Title II B Math and Science Partnership grant)

The goals of Science Masters Institute (SMI),were to increase middle school students’ achievement in science and to strengthen the quality of science instruction by providing professional development linked to Wisconsin’s Academic Standards for Science (WMAS) for middle school science teachers. In addition, research-based strategies were incorporated to develop student understanding of fundamental science content. SMI objectives were:

1. Teacher Knowledge: Increase science content knowledge of middle school teachers by offering high-quality content and inquiry-based courses taught by UW-Madison faculty supported by a secondary science resource teacher.
2. Improve Instruction: Improve participating teachers’ understanding of how students learn science content and ensure that new content knowledge is incorporated into the classroom y offering pedagogical and instructional supports.
3. Improve Curriculum Implementation: Enhance implementation of standards-based science curricula within classrooms by expanding teachers knowledge of the essential content and instructional strategies most relevant to middle school science.
4. Improve Student Achievement: Raise middle school student achievement in science as teachers with deeper content knowledge, understanding of student learning, and mastery of the curriculum teach more students over time.
5. Narrow the Achievement Gap: Reduce the achievement gap in science among all demographic sub-groups by helping teachers master key concepts they can use to adapt instructional goals, assessment strategies, and learning activities.

IUSSE (Title II B Math and Science Partnership grant)

Improving Understanding of Science for Students and Educators (IUSSE) was developed in response to a teacher needs assessment and student test results to improve science learning and achievement of students in grades 4 through 8 from 5 partner districts per year. IUSSE will increase the science content and pedagogical knowledge of teachers and result in changes in instruction as teachers participate in Understanding Science, a high-quality, field-tested and researched professional development program. In addition, the project aims to develop leadership capacity to support complex system change through outreach and education to building principals. Partner districts include the Madison Metropolitan School District (MMSD), Beloit, Delavan/Darien, Janesville, and Whitewater.

The 5 project goals are as follows:

1 Improve teachers' science content knowledge
2. Improve teachers' pedagogical knowledge
3. Enhance teachers' science instruction
4. Improve students' science achievement
5. Narrow the science achievement gap

Specific project activities are aligned to each goal. Goals 1 and 2 will be met by providing six summer institutes (30 hours over one week) with courses that meet teachers' needs for content-specific professional development in the areas of plate tectonics, weather and climate, heredity, selection, and adaptation, force and motion, matter, and energy. Goal 3 will be met by providing ten 2-hour sessions per year to support teachers as they work in a Professional Leaning Community (PLC) to analyze student work from their own classrooms, evaluate instructional "next steps," and modify their own lessons and assessments based on their students'' incorrect or partial understandings of the science, thus reinforcing and building their knowledge for teaching. Goals 4 and 5 will be met as teachers implement content and pedagogy skills acquired during the Summer Institutes and receive support through their PLC.

Partnership with WestEd and UW Educational Outreach Program

MMSD began its current partnership with WestEd in 2008. WestEd is a nonprofit, public research and development agency, which has been working at local, state, and federal levels for more than four decades. It develops intervention strategies, products, and services. WestEd also helps its clients assess students' knowledge of science, develop mentoring programs, create fair and effective standardized assessments to inform instruction, and improve programs for English learners and students with disabilities. The Understanding Science for Teaching project at WestEd has reached thousands of teachers and staff developers across the country, impacting hundreds of thousands of students. The project combines existing education research with knowledge of practicing teachers, staff developers, and scientists to collaboratively develop and refine professional development experiences for science teachers and staff developers.

We have been using the Understanding Science for Teaching - Making Sense of Science (MSS) materials and protocols with MMSD middle school science teachers through the Title IIB IUSSE grant explained above. The MSS teacher course materials provide all the necessary ingredients for building a scientific way of thinking in teachers and students with a focus on the intersection of science content, inquiry, and literacy. Teachers who participate in these courses experience hands-on science designed for adult learners and learn to facilitate hands-on lessons and support evidence-based discussion in the classroom, collaboratively explore the art of teaching, examine instructional moves and student thinking, analyze and refine their own practice and instructional strategies, and learn how to help develop students' academic language, reading and writing skills, and promote a scientific way of thinking and reasoning. We have also been involved in the development of some of the courses. Our future plan is to use MSS materials as our comprehensive K-8 professional development program..

Partnership with TERC around special education and science

TERC is a nonprofit research and development organization in Massachusetts dedicated to engaging and inspiring all students through stimulating curricula and programs designed to develop the knowledge and skills they need to ask questions, solve problems, and expand their opportunities. TERC currently has a

NSF funded grant to complete a field test project around testing new materials and strategies called content enhancements developed with the learning disability executive function disorder (EFD) in mind and aligned to the FOSS units, called Accessing Science Ideas. Content enhancements are worksheets, posters, hands-on word tiles and other materials that help students understand and remember science facts and relationships. They do not change instructional content but rather 'enhance' it by making it accessible to all learners. Researchers think that enhancements will make the science work more explicit thus improving the science achievement. Although the district has recently concluded its work on this project, the potential for future opportunities working with TERC remains open.

High School Science (9-12)

Science at the high school level in MMSD has been one of innovation and excellence through the years, yet it is struggling to respond to the changing nature of the student population. Each of the four comprehensive high schools has a staff of highly qualified teachers in a science department. There is a department chair selected by the principal on an annual basis.

Curriculum

Although they may have their own individual nuances in their name within their given high school, all four comprehensive high schools offer courses in: Biology, Chemistry, Math Physics 1 and Math Physics 2; the duration of these courses are all year-long or the equivalent Below is a comprehensive list of courses offered at the four high schools. Information for Shabazz City High School follows.

Grade (may vary by school)				Course Length *	*Name of Course*	Credit	School				MMSD Advanced Course
9	10	11	12				East	La Follette	Memorial	West	
❖	❖	❖	❖	Year	**Biology** Biology (E,M) General Biology I (L) Biology I (W)	1	❖	❖	❖	❖	
❖	❖			Year	**Biology Honors** Biology Honors (E) Honors Biology I (L) Biology I Accelerated (W)	1	❖	❖		❖	HR
	❖	❖	❖	Year	**Fundamentals of Biology**	1			❖		
	❖			Year	**Biology 2** Biology II	1		❖		❖	A
		❖	❖	Year	**Advanced Biology**	1	❖				A
		❖	❖	Year	**Conservation Biology**	1			❖		A
		❖	❖	Semester Year	**Anatomy & Physiology** Human Anatomy & Physiology (E) Anatomy & Physiology (M) Advanced Biology II (L) Advanced Biology (W)	05 - 1	❖	❖	❖	❖	A
		❖	❖	Year	**AP Biology**	1			❖		AP
		❖	❖	Year	**AP Environmental Science**	1			❖		AP
❖				Year	**Integrated Science**	1			❖		
	❖	❖	❖	Semester	**Physical Science Chemistry**	.5	❖				
	❖	❖	❖	Semester	**Physical Science Physics**	.5	❖				
	❖	❖	❖	Year	**Physical Science**	1		❖			
	❖	❖	❖	Year	**Practical Physical Science**	1		❖			

Grade (may vary by school)				Course Length *	*Name of Course*	Credit	School				MMSD Advanced Course
9	10	11	12				East	La Follette	Memorial	West	
	❖	❖	❖	Year	**Earth Science 1** Earth Science I (M) Earth Science (L,W)	1		❖	❖	❖	
		❖	❖	Year	**Earth Science 2** Earth Science II	1			❖		A
	❖	❖	❖	Semester	**Geology**	.5	❖				
	❖	❖	❖	Semester	**Geology Honors**	.5	❖				HR
	❖	❖	❖	Semester	**Meteorology**	.5	❖				A
	❖	❖	❖	Semester	**Limnology and Oceanography**	.5	❖				A
	❖	❖	❖	Semester	**Limnology & Oceanography Honors**	.5	❖				HR
	❖	❖	❖	Semester	**Astrophysics** Astrophysics (E) Advanced Astronomy and Astrophysics (W)	.5	❖			❖	A
		❖	❖	Year	**Astronomy**	1			❖		A
	❖	❖	❖	Year	**Chemistry** Chemistry (E) Math Chemistry (L, M) Chemistry (W)	1	❖	❖	❖	❖	
	❖	❖	❖	Year	**Chemistry Honors** Chemistry Honors (E) Honors Math Chemistry (L)	1	❖	❖			HR
			❖	Year	**Advanced Chemistry**	1	❖			❖	A
	❖	❖	❖	Year	**General Chemistry** Chem-Com Chemistry (M) General Chemistry (W) General Chemistry (L)	1		❖	❖	❖	
	❖	❖	❖	Year	**AP Chemistry**	1		❖	❖	❖	AP
	❖	❖	❖	Year	**General Physics** General Physics (M, W) General Physics (L)	1		❖	❖	❖	
	❖	❖	❖	Year	**Math Physics** Physics (E) Math Physics I (L) Math Physics (M) Accelerated Math Physics (W)	1	❖	❖	❖	❖	A
		❖		Year	**Physics Honors**	1	❖				HR
		❖	❖	Semester Year	**Math Physics 2** Math Physics II (L,M) Advanced Physics (E .5, W)	.5 - 1	❖	❖	❖	❖	A
			❖	Semester	**AP Physics B**	.5			❖		AP
			❖	Semester	**AP Physics C: Mechanics**	.5	❖				AP

Grade (may vary by school)				Course Length *	*Name of Course*	Credit	School				MMSD Advanced Course
9	10	11	12				East	La Follette	Memorial	West	
		❖	❖	Sem/Year	**Biotechnology**	.5 - 1		❖	❖	❖	AP
	❖	❖			**Adv Univ ResearchSciences** Advanced University Research in the Sciences (L, M, W) Science Internship in Science Research (E)	.25+	❖	❖	❖	❖	A
		❖	❖	Year	**Advanced Science & Engineering**	1		❖			A
	❖	❖	❖	Semester	**Forensic Science**	.5			❖		A
	❖	❖	❖	Year	**Mechanical World**	1			❖		
		❖	❖	Year	**Aerospace Engineering (PLTW)**	1			❖		A
		❖	❖	Year	**Principles of Biomedical Sciences (PLTW)**	1		❖	❖	❖	A
		❖	❖	Year	**Human Body Systems (PLTW)**	1		❖	❖	❖	A
		❖	❖	Year	**Medical Interventions (PLTW)**	1			❖		A
		❖	❖	Year	**Biomedical Innovations (PLTW)**	1			❖		A

Courses offered at Shabazz City High School are all nine week courses. Students of all class levels may take each course regardless of mathematics or science background. The following courses are those offered at Shabazz: General Chemistry I, II, III, IV; Cellular Biology I, II; Introduction to Microbiology; Evolutionary Biology Seminar; Introduction to Genetics; Genetics & Society; PGT Stream Ecology; Philosophy of Sciences; Bears, Wolves, and Wilderness; Energy Production; Physiology; Introduction to Organic and Sustainable Agriculture; Introduction to Evolutionary Biology; Physical Science: Mechanics; Comparative Anatomy; and Human Anatomy.

Beyond individual classrooms/courses within MMSD, the district is unique in that it houses it's own planetarium which provides an immersing experience for groups of students from MMSD, as well as public audiences, aimed primarily at Earth and Space Science (Astronomy) Education. The Planetarium brings out-of-this-world concepts down to Earth through its multi-media theatre that can simulate the sky for any date, time, and location on Earth on its ceiling to explore a vast array of concepts related to astronomy and space exploration. The planetarium is a unique tool for exploring difficult, and often abstract concepts related to our place in the dynamic universe. The Planetarium offers multiple automated and interactive programs for preschoolers-through adult. For a nominal fee and the cost of a bus, teachers within MMSD can take advantage of this facility and its offerings during the school day. Monthly scheduled programming for the public and the option to book your own program for outside districts and the general public is also offered through our Planetarium. The Planetarium had nearly 20,000 people attend shows during the 2010-11 school year.

In addition to course taken during the school year, high school students also have science opportunities that they can take advantage of during the summer months.

Outside of summer school courses, students in their Sophomore or Junior year of high school have the unique opportunity to apply to the High School Research Internship Program. This program is an informal partnership between the Madison Metropolitan School District (MMSD) and the University of Wisconsin-Madison. Students from MMSD are partnered with research professors at UW-Madison each summer. The goal of the program is to provide an authentic science research experience for the intern. Each intern develops and researches a question of their own, designs protocols for data collection, and collects data over the course of the summer under the guidance of a professor, degree candidate, postdoctoral candidate or research associate. As the summer ends and during the fall semester, interns write a formal research paper and design a scientific poster. The concluding event of the program is a scientific poster session, which allows the interns to communicate their findings to a larger audience and also to celebrate the completion of their internship with associates from the university, teachers, friends and family. Highlights of this program give interns the opportunity to:

- Participate in science research at the University of Wisconsin-Madison during the summer as a member of a research team
- Design and implement an extensive research project under the supervision of a research scientist
- Earn Credits:
    - three quarters of one high school science credit awarded by MMSD
    - one credit from UW-Madison awarded and paid by MMSD
- Learn how to use both high and low tech research tools and technologies
- Meet with other interns and tour their labs during the summer seminars
- Participate in high school research competitions (optional)
- Publish research in a professional journal at the discretion of the professor

There are also numerous opportunities for students to be involved in afterschool clubs that have a science focus.

District Support of Science

Connection with the School Forest trips

Our Madison School Forest is a treasure any time of the year. Connections to our science curriculum are plentiful. The Madison School Forest is a special place of natural beauty and biological diversity. It is a place to get away from the city, experience the quiet of the forest, and enjoy nature by being surrounded by and part of it. The property was purchase din 1958 and now encompasses over 300 acres. It is locate din the hilly terrain southwest of Verona in the unglaciated driftless area. The Forest includes the Olson Oak Woods State Natural Area, the Jerome Jones Pine Plantation, and an old field. These areas offer a variety of habitats to learn about, experience, and appreciate.

In addition to the hundreds of acres to walk and study in, the property includes a camping area and Nature Center. The camping area has a kitchen, four sleeping cabins, fire bowl, open pavilion picnic area, restrooms, and a hand washing station. The Nature Center houses an extensive collection of biological specimens, learning tools and equipment, and has a wood burning stove for use in colder weather.

MMSD was awarded a $20,000 grant from the Wisconsin Environmental Education Board (WEEB) in July 2003. The grant was submitted under the School Forest category, and was titled “A Research Connection: From the Classroom to the Madison School Forest”. The project was designed to promote district-wide implementation of the Wisconsin Model Academic Standards in both Environmental Education and Science by creating environmental field studies that engage teachers and students in connecting classroom science and outdoor learning experiences. The research and learning is focused on issues that are relevant both to the overall management of the Madison School Forest and core concepts in science and environmental education.

Support by District Instructional Resource Teachers

District-wide Instructional Resource Teachers work collaboratively to support science district-wide. This includes coordination of curriculum, assessment, technology and other resources to meet the needs of all students, as well as facilitation of professional development around science.

Instructional Time

The district recommends using the minimum amount of instructional time recommended by the Wisconsin Department of Public Instruction for elementary science education. Following is a list of grades Kindergarten through 5 and the recommended time allocations. The allocations are based on a six-hour school day.

Kindergarten - 10% of a day (179 minutes/week)
Grade 1 and Grade 2- 100 minutes/week
Grade 3 and Grade 4- 150 minutes/week
Grade 5 - 175 minutes/week

State Statute 121.02 L requires that in grades 5-8, "provide regular instruction in ...science..." Regular instruction means instruction each week for the entire term in sufficient frequency and length to achieve the objectives and allocation of instructional time identified in the curriculum plans. All middle school students take a science class in grades 6-8.

At the high school level, Wisconsin State Statute 118.33 criteria for promotion regarding science include, "two credits of science, which incorporate instruction in the biological sciences and physical sciences". In Wisconsin's NCLB waiver request, State Superintendent Tony Evers has recommended an increase in high school graduation criteria, specifically increasing science from two credits to three, of which two should remain traditional science or science equivalency credits.

Certification

An elementary certification allows an educator to teach science in a self-contained class, as well as in a departmentalized or other school organization pattern. A license in a discrete content field is required if the content course is offered for graduation credit. Therefore, the following licenses are required for to teach the following courses:

- 600 Science (all) *(for program completers before 7/1/1980)*
    - May teach anything in the 600 science range at the appropriate grade range.
- 601 Broadfield Science *(for program completers 7/1/1980-8/31/2004)*
    - May teach any science up through grade 9 (within specific grade levels of the educator's license).
    - May teach any science for grades 10-12 EXCEPT discrete courses in Biology (605), Chemistry (610), Physics (625), and Earth/Space Science (635).
- 601 Broadfield Science *(for program completers 8/31/2004 - present)*
    - A person with a broad field science license issued under PI 34 rules may teach any science class at the early adolescence-adolescence level, up through grade 10, and any basic or fusion science class in grades 11-12 that is not: A) a semester-long discrete course in a PI 34 science subcategory - e.g. life and environmental science; B) an honors, IB, or advanced placement course; C) part of the college preparatory sequence and/or an elective course with more depth of content than basic courses. To teach a course under the criteria in A, B, or C (above), the teacher must hold a license based on completion of at least a concentration in that subject area.
- #27-620 General Science
    - May teach any science for grades 7-8.
    - May teach general science and physical science (637) for grade 9.
    - May teach general science for grades 10-12.
- #37-621 Science
    - May teach any science for grades 6-8.
    - May teach general science and physical science (637) for grade 9, (including for high school credit).
- #46-621 Science
    - May teach any science for grades 1-8.
    - May teach general science for grade 9, (including for high school credit).
- 635 Earth/Space Science
    - May teach any Earth or Space Science including Astronomy (627).

Providing highly qualified teachers to all science students remains an important goal for the district.

Chapter 7

Best Practices in K-12 Science Education

With the advent of the Next Generation Science Standards (NGSS), what constitutes "best practice" in science education is changing. However, we know enough of what the new standards contain to begin to identify specific practices that will situate the District to be prepared for the shift to the new expectations.

Madison has long been viewed as a leader in many aspects of its science programs. This is well deserved, as many teachers, leaders, and community partners have worked long and hard to ensure excellence for Madison students. Yet the district finds itself in changing times, and must work for continuous improvement in all its programs. This is the only way that the district will be able to serve all students and continue to provide a nationally recognized science program. The programs listed below are intended to provide guidance to this end.

For several years, the focus of K-8 science has been The Inquiry Cycle. This is defined as a five part cycle that allows students to ask science-based questions, collect data, draw a conclusion, and present or defend that conclusion. This is what the district has built its K-8 science program on.

With the advent of the NGSS, the focus shifts from Inquiry as a scientific process to the 3 Dimensions as described in the Frameworks document (for more detail, see Chapter 8). These 3 Dimensions are *Scientific and Engineering Practices*, *Cross-cutting Concepts*, and *Disciplinary Core Ideas*. Inquiry now appears as embedded within the Practices as just one of the critical components of deep science learning.

Fundamental to the NGSS is the concept of Learning Progressions. Learning progressions have been described elsewhere, but generally they are a map of science concepts that are needed to know before a student can learn the next concept. Think of them as the project timeline at a construction site. What must happen before the walls go up? What must happen before the electrical work can be completed? In the same manner, science progressions might look like this: What learning must be in place before a student can understand the concept of "scale" – whether microscopic or astronomic? What concepts must be understood before a student can truly grasp the concept of the water cycle?

As the District awaits the completion of the NGSS, the Atlas of Science Literacy from the American Association for the Advancement of Science can provide a guide for science conceptual learning progressions. The district can use these maps to begin the process of aligning curriculum and ensuring that it develops conceptually from Kindergarten through high school.

Several science programs are considered to be stand outs in the United States. In 2008, US News & World Report rated all the top high school science programs in the United States. While most of the schools were either charter schools or magnet schools taking students by application only, there were several that are public, open high schools. Many of these schools can be found in known areas of intense technology industry: Silicon Valley in California and Research Triangle in North Carolina. The value of these high achieving science schools should not be overlooked, as there is much to learn from what success they are having. However, direct application of programs to the size and demographic profile of MMSD's high schools is not appropriate, as there are too many differences.

When looking at schools with similar demographics to MMSD high schools, there are several schools in the New York City area that stand out: Yonkers High School and Newcomers High School in Long Island City. These schools have overcome mediocrity to become some of the best science programs in the country.

The Boston Public Schools has a long history of taking the FOSS science program and extending it beyond the module. There is a strong, comprehensive and differentiated professional development program for all teachers who support student learning through the FOSS program. There is also a very strong component of place-based learning through their School Yard Science program. This incorporates the FOSS modules and the available resources in and around district schools.

As MMSD looks to include concepts of sustainability in all its programs, the Berkley, CA school system is a well-recognized model for this. A middle school in Berkley is the inspiration for the Edible School Yard project, bringing gardening and food deep into the daily routine of students. Several districts in Colorado have also been leading the efforts to bring sustainability into the classroom.

Turning to a more local program, the Milwaukee Public Schools has developed an excellent local business/school science partnership. This program brings together district science leaders with local business leaders to both learn about and move forward science education within the district.

Finally, there are many districts around the country that have brought together the traditional science program with Career and Technical Education courses to provide multiple, high quality options for students to enter scientific careers. The Milwaukee School of Engineering is a National Affiliate with the Project Lead the Way programs and has proven to be an excellent partner in developing strong programs that cross traditional content boundaries.

This brief chapter is in no way intended to provide an exhaustive listing of top notch programs. Attention should be paid to constantly looking for ways to improve the district science program. This includes networking with schools and districts as the NGSS are unveiled and implemented, so that through discussion and problem-solving, the MMSD can continue its excellence in science programming.

Chapter 8

Preparing for the Next Generation Science Standards

About the Next Generation Science Standards

It is important to note that at the time of the development and writing of this program review, both the state and nation are in flux regarding science education and the new science standards. This report relies heavily upon the Frameworks for K-12 Science Education Standards document published by the National Academy Press. Changes after the final version of this document may prove reason to adjust some of the reports recommendations.

Development process, who "is at the table"

A state-led effort to develop the new science standards - called Next Generation Science Standards (NGSS) - is under way. Managed by Achieve Inc., the process involves science experts, science teachers, and other science education partners. The first draft of the NGSS will appear in spring 2012 with the final version most likely appearing in early 2013. The writers are a cross-section of educators, supervisors, scientists, engineers, and policy makers and other interested parties in science education. The come from many different states and diverse backgrounds and areas of expertise including but not limited to urban education, early science development through post high school, English Language Learners, diverse learners and all content areas.

The NGSS includes a chapter and vignettes, which specifically address non-dominant groups in science education. The NGSS provides recommendations for utility of the new science standards to improve learning and close the achievement gap.

The Framework document and it's use in this report

A Framework for K-12 Science Education Standards represents the first step in a process to create new standards in K-12 science education - Next Generation Science Standards (NGSS). A large number of states adopted common standards in math and English/language arts and are poised to consider adoption of common standards in K-12 science education as well. There is new knowledge gained from recent research on teaching and learning in science that can inform a revision of the current standards and recharge science education.

> The Framework document is divided into 3 Dimensions, each one described below:
>
> A framework has been created and is comprised of three dimensions. They broadly outline the knowledge and practices of the sciences and engineering that all students should learn by the end of high school. Most importantly, the framework represents the most current research of the developmental progression that students undertake in science learning. The framework allows for students to build on each years' understandings within their entire school experience.

How would the application of the NGSS look in a K-12 science program?

NGSS uses the framework to design science standards built on four key concepts. It implements fewer and more rigorous core concepts; integrates or "fuses" scientific and engineering practices with core concepts; includes cross-cutting concepts and reinforces the development of scientific practices, core concepts, and cross-cutting concepts over time. Finally NGSS offers connections to Common Core literacy and math standards.

It is thought that the scientific and engineering practices will represent the means of instruction as well as the outcomes of science instruction. Students will develop a deeper understanding of the core ideas and cross-cutting concepts through learning the scientific and engineering practices around content. They also gain an understanding of how scientific knowledge and engineering design develops and progresses as a result of the practices. The fusing of practices with concepts mandates an active project-based hands-on or laboratory experience in the classroom.

Dimension 1: Practices

What are the practices that are recommended?

Dimension 1 describes scientific and engineering practices. These include the major practices that scientists use as they investigate and build models and theories about the world. They also include a key set of engineering practices that engineers use as they design and build systems. The terms "practices" is used to emphasize that skills and knowledge are both important.

There are eight scientific and engineering practices:

1. Asking questions (for science) and defining problems (for engineering)
2. Developing and using models
3. Planning and carrying out investigations
4. Analyzing and interpreting data
5. Using mathematics and computational thinking
6. Constructing explanations (for science) and designing solutions (for engineering)
7. Engaging in argument from evidence
8. Obtaining, evaluating, and communicating information

The articulation of the practices in Dimension 1 is to better explain what is meant by inquiry in science. They specify the range of cognitive, social, and physical practices that is required in inquiry. Students will themselves engage in the practices and not merely learn about them secondhand. They need to directly experience the practices for themselves in order to comprehend the scientific practices and the nature of scientific knowledge itself.

Dimension 2: Crosscutting Concepts

What are "crosscutting concepts"?

They are concepts that have application across all domains of science. They provide one way of linking the domains in Dimension 3. They are not unique to the Framework, but are closely related to the unifying concepts and processes in the National Science Education Standards, the common themes in the Benchmarks for Science Literacy, and the unifying concepts in the Science College Board Standards for College Success. They are, in short, the ideas and practices that cut across the science disciplines.

How should they fit in with a K-12 Science scope & sequence?

The NGSS cross-cutting concepts reinforce high levels of consistency among the goals and objectives, instruction and assessment of each domain of science and across grade levels. Furthermore, implications for connection to cross-cutting concepts across other content areas should also be explores and will enhance comprehension for all students. For example, patterns could be explored in science as well as music and art.

These crosscutting concepts bridge disciplinary boundaries, having explanatory value throughout much of science and engineering. They were selected for their value across the sciences and in engineering. They help provide students with an organizational framework for connecting knowledge from the various disciplines into a coherent and scientifically based view of the world.

There are no grade band endpoints for the crosscutting concepts, a hypothetical progression for each is laid out. Students' facility with addressing these concepts and related topics at any grade level depends on their prior experience and instruction.

What changes does this call for in K-12 science education?

Students' understanding of these crosscutting concepts should be reinforced by repeated use of them in the context of instruction in the disciplinary core ideas of science. In turn, the crosscutting concepts can provide a connective structure that supports students' understanding of sciences as disciplines and that facilitates their comprehension of the systems under study in particular disciplines. They should not be taught in isolation from the examples provided in the disciplinary context. Use of a common language for these concepts across disciplines will help students recognize that the same concept is relevant across different contexts.

What are the Crosscutting Concepts that are recommended?

There are seven crosscutting concepts that have been identified in the framework. They are listed below:

1. Patterns
2. Cause and effect: Mechanism and explanation
3. Scale, proportion, and quantity
4. Systems and system models
5. Energy and matter: Flows, cycles, and conservation
6. Structure and function
7. Stability and change

Dimension 3: Disciplinary Core Ideas

What is meant by Disciplinary Core Ideas?

The framework focuses on a limited set of core ideas in order to avoid the coverage of multiple disconnected topics. This focus allows for deep exploration of important concepts, as well as time for students to develop meaningful understanding, to actually practice science and engineering, and to reflect on their nature. It also results in a science education that extends in a more coherent way across grades K-12.

The continuing expansion of scientific knowledge makes it impossible to teach all the ideas related to a given discipline in exhaustive detail during the K-12 years. An education focused on a limited set of ideas and practices in science and engineering should enable students to evaluate and select reliable sources of scientific information, and allow them to continue their development well beyond their K-12 school years as science learners.

The committee developed a small set of core ideas in science and engineering by applying the criteria listed below. Each core idea must meet at least two of the four criteria.

1. Have broad importance across multiple sciences or engineering disciplines or be a key organizing principle of a single discipline.
2. Provide a key tool for understanding or investigating more complex ideas and solving problems.
3. Relate to the interests and life experiences of students or be connected to societal or personal concerns that require scientific or technological knowledge.
4. Be teachable and accessible for learning over multiple grades at increasing levels of depth and sophistication. That is, the idea can be made accessible to younger students but is broad enough to sustain continued investigation over years.

What are the Core Ideas?

The core ideas are grouped into four major domains: the physical sciences; the life sciences; the earth and space sciences; and engineering, technology, and applications of science. There are multiple connections among domains. In some instances core ideas, or elements of core ideas, appear in several disciplines.

Each core idea and its component are introduced with a question designed to show some aspect of the world that this idea helps to explain. The question is followed by a description of the understanding about the idea that should be developed by the end of high school. The structure is intended to stress that posing questions about the world and seeking to answer them is fundamental to doing science.

The physical sciences section has been organized under four core ideas: Matter and Its Interactions, Motion and Stability: Forces and Interactions, Energy, and Waves and Their Applications in Technologies for Information Transfer. The life science section has been organized under the following four core ideas:

From Molecules to Organisms: Structures and Processes, Ecosystems: Interactions, Energy, and Dynamics, Heredity: Inheritance and Variation of Traits, and Biological Evolution: Unity and Diversity. The Earth and space sciences section has been organized under the following three core ideas: Earth's Place in the Universe, Earth's Systems, and Earth and Human Activity. The engineering, technology, and applications of sciences section has been organized under the following two core ideas: Engineering Design and Links Among Engineering, Technology, Science, and Safety.

The effort to identify a small number of core ideas may disappoint some people, but the committee is convinced that by building a strong base of core knowledge and competencies, understood in sufficient depth to be used, students will leave school better grounded in scientific knowledge and practices - and with greater interest in further learning in science - than when instruction covers multiple disconnected pieces of information that are memorized and soon forgotten once the test is over.

What is the importance of connecting all three?

The inclusion of core ideas related to engineering, technology, and applications of science reflects an increasing emphasis at the national level on considering connections between science, technology, engineering, and mathematics. It is also informed by a recent report from the NRC on engineering education in K-12, which highlights the linkages - which go both ways - between learning science and learning engineering.

How this is connected to Learning Progressions across K-12.

The framework emphasizes developing students' proficiency in science in a coherent way across grades K-12 following the logic of learning progressions. Developing detailed learning progressions for all of the practices, concepts, and ideas that make up the three dimensions was beyond the committee's charge. They do, however, provide some guidance on how students' facility with the practices, concepts, and ideas may develop over multiple grades.

For the disciplinary core ideas, a set of grade band "endpoints" is provided for each component idea that describe the developing understanding that students should have acquired by the ends of grades 2, 5, 8, and 12. These endpoints indicate how this idea should be developed across the span of the K-12 years. In standards, curriculum, and instruction, a more complete sequence that integrates the core ideas with the practices and crosscutting concepts will be needed. When possible, the grade band endpoints were informed by research on teaching and learning, particularly on learning progressions.

The endpoints follow a common trend across the grades. In grades K-2, ideas about phenomena that students can directly experience and investigate, are included. In grades 3-5, invisible but chiefly still macroscopic entities are included. When microscopic entities are introduced, no stress is placed on understanding their size. In grades 6-8, students are moved to atomic-level phenomena that they can investigate and interpret. Finally, in grades 9-12, study shifts to subatomic and sub-cellular phenomena of large scales and deep time.

The progression for practices across the grades follows a similar pattern, with K-2 stressing observations and explanations related to direct experiences, grades 3-5 introducing simple models that help explain observable phenomena, and a transition to more abstract and more detailed models and explanations across the grades 6-8 and 9-12. The idea behind these choices is not that young children cannot reason abstractly or imagine unseen things, but that their capacity to do so in a scientific context needs to be developed with opportunities presented over time. There is ample opportunity to develop scientific thinking, argumentation, and reasoning in the context of familiar phenomena in the K-2 grades, and that is the experience that will best support science learning across the grades.

Chapter 9

Making Connections Across Content Areas

Why is connecting across content areas important?

How people understand science – the research

Studies show that children as young as kindergarten age have a sophisticated way of looking at natural phenomenon that occurs within the world (ex: the way objects fall or collide, or observing plants and animals). Experiences of students outside the world, such as conversations with families, watching television, or having outdoor experiences influence the way children learn about the way the world works. Children also have a greater capacity to reason scientifically than they are often given credit for. These advanced ways of thinking can serve as a foundation for later, more sophisticated ways of thinking scientifically is they are built upon, rather than it is assumed they are certain cognitive stages that students must pass through in order to develop these capabilities as was the previously accepted view.

Science and Literacy

Science is a social enterprise; it is conducted by large groups or widespread networks of scientists. Scientists talk both formally and informally with their colleagues; they exchange emails, engage in discussion at conferences, and present and respond to ideas via publications.

In order to make sense of science ideas, observations and experiences, students must talk about them. Talk forces students to think about and articulate ideas as well as allows students to think about what they do and do not know [pg. 88, Ready Set Science]

Scientific literacy-in science, words often take on a meaning different and often more precise than its every day meaning.

As the Smarter Balanced Assessment information is shared with the public, we now know that non-fiction literacy and technical writing will be key components of the new assessment. Students will have to read and write more technical literature than they have had to in the past. The new assessment looks at the following as an appropriate "balance" between fiction and non-fiction reading and writing in a typical student's day:

- Elementary students should experience 50% of their daily literacy with non-fiction, technical reading and writing.
- Middle school students should experience 60% of their daily literacy with non-fiction, technical reading and writing.
- High school students should experience 70% of their daily literacy with non-fiction, technical reading and writing.

These are the expectations, using the Common Core State Standards, for being able to achieve proficiency on the new assessments.

Science notebooks

Science notebooks are a natural complement to kit-based programs in which students are actively engaged with materials, involved in small-and whole-group discussions, and using expository text as a reference to confirm or extend ideas after investigations. In the elementary school classroom, science notebooks are a record of students' findings, questions, thoughts, procedures, data, and wonderings that may or may not retell the journey of their science experience.

Notebooks are meant to be tools for students to record both their data and thinking as they work with materials. They are utilized prior to the investigation to record the students/ thinking or planning; during the investigation to record swords, pictures, photos, or numbers, possibly getting wet and messy in the process; and after the investigation to help students reflect on their thinking and data in order to share them with others.

As students use their notebooks, they become formative assessment tools for both the teacher and the students, serving as an aid in terms of making learning decisions. They are not used by the teacher for summative assessment, nor are they a graded product. Rather, notebooks are tools for informing the teacher if students are meeting predetermined goals or if more instruction needs to be given.

Besides building scientific content and replicating the work that scientists do, great potential exists for notebooks to support the development of literacy through reading, writing, and speaking. When used to their full potential, science notebooks help promote the idea that science is a context for literacy development.

Non-fiction reading

Non-fiction reading is growing in its importance for K-12 education. We know the following to be true at the national level:

- There is a new emphasis being placed on time spent reading non-fiction
- The Common Core standards require increased attention to non-fiction reading. They require that 50% of the reading in school in early elementary grades needs to be non-fiction, increasing to 60% in upper elementary grades and 70% by high school. In addition, students who struggle in literacy are benefited by reading texts that revolve around contextually embedded experiences in the classroom.
- In this vein, science content learning should be developed in combination with literacy skills and vocabulary building in order to reinforce new learning in both content areas in a cross-curricular manner. Classroom hours focused on literacy would not compete with the science hours, but rather bridge them.

Students should be provided with authentic opportunities to construct and defend explanations. When students are given opportunities to “do” science, they often take the form of an activity or lab and unfold in a “scripted” manner. Productive investigations should be purposeful, build social interaction that supports cognitive process and focus their efforts on pushing students’ thinking about science to new levels. Using a framework that includes looking at what and why things happen, what supports this and the justification for this data allows students to make sense of what they are studying, articulate their understanding and defend their understanding (claim, evidence, and reasoning) [Ready, Set, Science]

Technical writing

Science and Mathematics

Becoming more familiar with several content areas allows for one to see the similarities, as well as the differences between them. As we seek to understand the larger impact of the Common Core State Standards in Mathematics, it is helpful to look at the similarities with the Next Generation Science Standards.

If one where to place the Mathematical Practices along side of the Scientific and Engineering Practices, one would likely see very little differences at the macro level. The alignment is stunning. This provides a great starting point for future discussions in the ever growing STEM initiatives. Students and teachers will need to understand the close ties each of these areas, Science, Technology, Engineering, and Mathematics has with each other and other content areas (including the creative content areas).

Mathematics provides scientists with a way to share, communicate, and understand science concepts. Mathematically expressing ideas often leads to discoveries of new patterns or relationships that might not be seen. In science, mathematics and computation are fundamental tools for representing physical variables and their relationships. These tools are used for a range of tasks, including constructing simulations, the statistical analysis of data, and recognizing, expressing, and applying quantitative relationships. Mathematical computational approaches enable predictions of the behavior and allow for the testing of such predictions. Statistical techniques are greatly assisted in the assessment of significance of patterns or correlation. In engineering, mathematical and computational representations of established relationships and principals are an integral part of the design. Simulations of designs provide a way to effectively test the development of designs and make improvements.

Science and Technology

Scientists develop models and representations as way to think about and interpret the natural world. The kinds of models vary greatly within disciplines. Using models is another important way that scientists can make thinking visible. Modeling involves the construction and testing of representation of systems that are analogous to those in the real world and can take on many forms: physical models, compute programs, diagrams, mathematical equations, and propositions.

Data modeling is central to several scientific endeavors such as engineering, natural sciences, and medicine. Students are better able to understand data if they the focus of understanding is around how it was generated versus the analysis of it. Understanding the purpose of data in answering questions is what allows for the determination of the types of data and information that will be gathered. Data is inherently abstract as they are observations that stand for concrete events and may take on many forms. Collection of data requires the use of many tools such as microscopes, balances, probes, etc., and can be represented in various ways: graphs, tables of various kinds, distributions, etc. Interpreting data looks at relationships and patterns and the levels of complexity they entail. Interpretation of data often leads to using various statistical measurements to gain a deeper understanding of the data as well as the limits of the data.

New insights from science often catalyze the emergence of new technologies and their application which are developed using engineering design. In turn, new technologies open new opportunities for scientific investigation. Together, advances in science, engineering, and technology have had profound effects on human society in areas such as agriculture, transportation, health care, and communication. The fields of science, engineering, and technology have interdependence and are mutually supportive [pages 7-8, A Framework for K-12 Science Education].

The Tools of Science

Because data usually do not speak for themselves, scientists use a range of tools including tabulation, graphical interpretation, visualization, and statistical analysis to identify the significant features and patterns in the data.

The importance of working with data, not being focused on data collection

Scientific investigations produce data that must be analyzed in order to derive meaning. Sources of error are identified and the degree of certainty calculated. Modern technology makes the collection of large data sets much easier, thus providing many secondary sources for analysis.

Engineers analyze data collected in the tests of their designs and investigations: this allows them to compare different solutions and determine how well each one meets specific design criteria - that is, which design best solves the problem within the given constraints. Like scientists, engineers require a range of tools to identify the major patterns and interpret the results.

Ability to model data

Science often involves the construction and use of a wide variety of models and simulations to help develop explanations about natural phenomena. Models make it possible to go beyond observables and imagine a world not yet seen. Models enable predictions of the form "if . . . then . . . therefore" to be made in order to test hypothetical explanations.

In engineering, mathematical and computational representations of established relationships and principles are an integral part of design. For example, structural engineers create mathematically-based analyses of designs to calculate whether they can stand up to the expected stresses of use and if they can be completed within acceptable budgets. Moreover, simulations of designs provide an effective test bed for the development of designs and their improvement.

Science and Engineering

Importance of problem solving and solution design

Just as science begins with a question about a phenomenon and seeks to develop theories that can provide explanatory answers to such questions, engineering begins with a problem, need or desire that suggests an engineering problem that needs to be solved. Engineers ask questions to define the engineering problem, determine criteria for a successful solution, and identify constraints.

Models and simulations

Models are used by scientists to explain phenomena and test those explanations. They are used by engineers for designing solutions and testing the design. Students will be engaged in what it means to do science because models drive scientific thinking. Instead of being given a model that scientists have already derived (as is often done in schools today) students practice how the model building is an integral part of the scientific and engineering process.

Through constructing models based on evidence, students learn how scientists use models to attempt to explain phenomena (and how engineers design solutions.) When the model is not consistent with evidence, the students have to throw out the working model and try an alternative, all the while exploring the concept at hand at a deeper level.

Finally, by developing and refining models many times in repeated attempts to answer a scientific question, students learn content through scientific practice. They strive not only to explain natural phenomena but to demonstrate how their models are consistent with the evidence they collected. In addition, they must explore the limitations of those models. Students need to recognize that models highlight key characteristics but are not complete or accurate representations. They simplify events for the purpose of the objective of the model. In addition, students can learn that multiple models are possible and can be valuable for discussion and comparison.

Engineering makes use of models and simulations to analyze existing systems so as to see where flaws might occur or to test possible solution to a new problem. Engineers also call on models of various sorts to test proposed systems and to recognize the strengths and limitations of their designs.

Engaging in practices of sciences as well as practices of engineers helps students understand how scientific knowledge develops as well as give them an understanding and appreciation for the wide range of approaches that are used to investigate, model and explain the world.

The actual doing of science or engineering often piques students' curiosity, interest, and motives their continued study of these areas. The ability of students to recognize the importance of science and engineering contributions to society allows for an understanding of the implications of science and engineering without marginalizing them to simple products of scientific labor.

Science and engineering are similar in that they both involve multiple, creative processes. Science and engineering have both been defined/described in different ways; however, engineering differs slightly than science in that there is widespread agreement on the broad outlines of the engineering design process.

The design process involves problem definition, model development and use, investigation, analysis and interpretation of data, application of mathematics and computational thinking, and determination of solutions. These engineering practices incorporate specialized knowledge about criteria and constraints, modeling and analysis and optimization and trade-offs.

Placed-based Science

The place is more than simply a name of a location. It is the people who live there; it is the land, the plants and animals, the water, the air, and the soil (A Sense of Place, 1999). It is the history and the stories that connect everything together. Without a sense of place, we can lose ourselves, and we can destroy the place. How do we help children find their sense of place when many of us do not feel connected to where we live? Learning together and rediscovering a sense of wonder is the first step in the process.

Using local resources to teach science concepts

According to Rachel Carson, children need direct contact with nature. They need to be outside. They need to explore, get dirty, and find stuff. They need to have fun! Teachers can help reintroduce children to their home ground. They can begin by celebrating the local area. It is close by. It has meaning. The kids already know something about it, and there is much to do and learn nearby. They place where we grow up has a permanent impression on us, both consciously and unconsciously. It is the benchmark that we use to compare to everywhere else, the place that holds memories. Teachers can help give their students a connection to a place.

Environmental educators are beginning to recognize the power of place in a child's environmental and science education. Many believe that environmental education should be local in order to be meaningful. Materials should help children connect to their own unique place. Rather than using textbooks written for the mass market are general in focus and are geared to the widest possible audience, children should be taken outdoors to learn about the place where they live.

Richness of resources in Madison

Madison is a community rich in resources. The Madison community takes pride in its environmental awareness and stewardship. The school district is nestled among two large lakes and other waterways providing numerous opportunities for students to learn from these living laboratories. The Madison School Forest boasts over 300 acres of natural biological diversity for students to enjoy rustic camping experiences, exploration, and environmental learning through hands-on experiences.

The array of natural resources within a short distance of all the MMSD schools is breathtaking! There is a need to capitalize on what resources are close at hand. Some of these resources are well known, while others are waiting to be discovered by more students. It is of critical importance that we engage students in deepening their connections and sustainable us of our local resources. This can be done through many ways in the science curriculum, as well as other content areas.

Education for Sustainability

This is a very new concept, one that is just gaining a hold in district conversations. The foundational premise of Education for Sustainability (EfS) is that our students need to learn the interconnectedness of all things on the planet, that our decisions today have a direct impact on how we, and our children, will live tomorrow.

The district is working on a Sustainability Plan that includes EfS. In discussions about the integration of EfS in the district, science seems to be positioned well lead the district as it works to incorporate these concepts into curricula. This is an area of continuing conversation and work.

Chapter 10

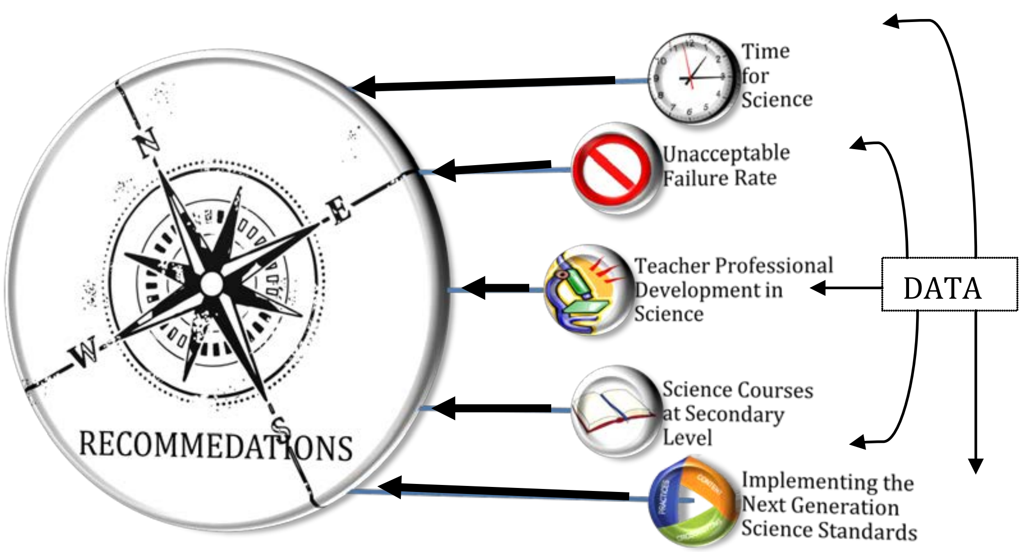
Synthesis

This chapter is designed to provide a direct link between the presented data to recommendations provided. This is to serve as a filter of some of the intangible things that are known. These intangibles are varied in nature, from experiences of teachers, to discussions with national science leaders, to the future form of standards and evaluation. While some of these things cannot be directly measured, their impact on our district can and will be profound.

What is the story, beyond the data points, that can be told about a program? What are the norms of practice to be found in the many dynamic settings that are called "school buildings"? How do building cultures impact the way work gets done in the district? What are the connections between teachers, parents, and community members as they all work to support improved student achievement?

There are concerns of the committee that go beyond the story that data points tell. This chapter contains five key points, that add to the data from Chapter 5 and that help to inform the recommendations made in the next chapter. These key points are all interrelated. Action taken on one key area has an effect on the others, driving the entire science program in one direction or another. The committee feels that through the implementation of the recommendations in the following chapter, true science program improvement *for increased student achievement and opportunity* will occur. The interconnectedness of these key concepts can be illustrated by Figure 9.1.

The key issues which are explored in this are addressed in no particular order. Since they are all interconnected and changing one has a "ripple effect" on the others, consistent, district-wide action to address the recommendations will have a multiplier effect. The issues below are also address in the recommendations chapter.



Key Issue #1: Time for Science

The issue of *Time for Science*, as all the others, has an effect that is magnified year after year. With the increased national and district push on literacy improvement, elementary schedules have dramatically shifted. Our data has shown that science, if it is taught at all, often takes a back seat to literacy and mathematics. We understand the critical moral and ethical issues in moving literacy to the forefront. However, we believe that science can provide a strong context for the literacy and mathematical tools that students are learning.

The only way to acquire deeper understanding is to take the time to teach science. Lost time and content do accumulate: we see this with the current lack of knowledge students have regarding human body systems. As teaching this component of life science has been given to the health curriculum, student understanding appears to have decreased. Health teachers are doing a good job teaching, but the curriculum was already full when this content was given to them. The amount of time students spend in health classes learning about human body systems is not nearly enough to get a deep understanding. This committee advocates for bringing the study of human body systems back into the science curriculum and that the health curriculum continue to teach it as well

A district committee, comprised of representatives from literacy, math, science, social studies, fine arts, and library media, has come together over the course of the 2011-12 school year to address the issue of elementary schedules. A model schedule was developed for grades K through 5, and the committee suggests that it should be piloted and supported in one or two elementary buildings in the 2012-13 school year. This would allow the students attending those schools the opportunity to experience instruction inclusive of all content areas with an integrative approach to teaching and learning. These building(s) would serve as a model to others in the future.

In order to support the district goal of improved literacy for all students while simultaneously improving science, a second broad-based committee worked on the integration of content areas and literacy. A model of integration was developed and it should be piloted in one or two schools next year, possibly in the same schools using the recommended DPI minutes of instruction in their schedules. District support and professional development could be provided for the instructional leaders and teachers in these buildings to help move the work forward. It is the next action step that should be taken with both of these initiatives. It directly addresses the issue of time for science and the integration of literacy, math, and science. It will provide the answer to the question, “Is this possible?”

Key Issue #2: Unacceptable Failure Rate

The second key issue to be addressed is the unacceptably high failure rates of students in science, especially at the 9^{th} grade level. In one high school, nearly 50% of all students taking freshman level science are failing. At another high school, until the 2011-12 school year, approximately 70% of the freshman course took science as 9^{th} graders; 30% of students did not. This has serious consequences from a scheduling standpoint for the remaining years of a student’s high school career.

In looking at the data (see pages 61 and 62 of this report), it is evident that there is a disproportionality among the ethnic status of students who are failing. While African American students make up approximately 20% of freshman students, the percentage of African American students receiving failing grades in freshman science is 43%. This is clearly an achievement gap issue, one that is being addressed at the district level. It cannot, however, be assumed that only district actions will close the gaps. Rather, it will be through actions in the content areas, at the classroom level coordinated with building and district actions that will produce the greatest gains in student achievement by those students who are not achieving now.

The committee hypothesized as to what are some of the root causes of this disparity: 9^{th} grade is a big transition year into high school, there are different, more rigorous expectations regarding homework and level of expectations, students do not have daily access to a textbook outside of class, teaching styles are different from middle school to high school, etc. Transitions have been deeply studied by experts nation-wide; we know the fundamental reasons that students have difficulty changing from elementary to middle school and from middle school to high school. Issues that have not been explicitly addressed in MMSD's science programs include instruction strategies for teaching in a culturally relevant manner, for teaching students who have a language barrier, and for having timely data regarding student performance.

Progress is being made in this area, however. Several schools report meetings between high school departments and middle school teachers of the same content area with the focus on transitioning students successfully. These open dialogues have proven to be more about understanding what is happening and expectations at each level rather than on pointing out blame. This open dialogue between feeder schools is something that needs to continue and be supported by district and building leaders. Decreasing teacher isolation and increasing collaboration are steps forward in closing the achievement gap.

Opportunities need to be provided for teachers at different levels to meet to talk about their science programming and the impact it has on student learning. Vertical teaming among teachers can be invaluable as students transition from one level to another, as well as from one building to another. We need to continue to support teachers in this endeavor and even expand the efforts in 2012-13 and beyond. Conversations between grade 5 and grade 6 teachers and between grade 8 and grade 9 teachers are essential to providing successful learning experiences for our students.

Time is the resource that is necessary for this to happen. Leadership teams from different levels (ES, MS, HS) could meet at overlapping times to accommodate common time to talk. We are currently providing time for teachers from a single level to meet together to have dialogues and discussions, but we need to provide a structure in the future to allow for the crossover to happen. As we reestablish the practice of having science teacher contacts/leaders at all of the buildings across the district, we can invite various teams to overlap in their meeting times once or twice during the 2012-13 school year to build bridges across buildings and grade levels.

As stated in the paragraph above, elementary, middle, and high school teachers must be given time to work together to provide reading materials and experiences that are appropriate for all students in their science classes. This time could occur during after-school hours or during the summer months. In both cases, teachers need to be compensated for the time they spend doing this important work. It would also be beneficial to have literacy teachers in the district collaborating with them. Connecting the Common Core Standards and the Next Generation Science Standards to our work in science is essential to helping our students achieve success in their ninth-grade experiences in science, as well as at all other grade levels.

Key Issue #3: Teacher Professional Development in Science

While the data from the teacher survey (found in Chapter 5, pages 63-71) was helpful to the committee's work, there were many questions raised as a result of the data obtained. The first "red flag" for the committee was the return rate by elementary teachers. Both Middle School and High School teachers had a higher return rate. Thus, drawing strong conclusions from the data is difficult. If anything, the data provided "suggested" answers for what committee members have seen and wondered about.

The importance of teacher preparation in the sciences cannot be overstated. Most elementary teacher will have had 1-2 courses in science during their college careers. The State of Wisconsin requires an Environmental Education course for certification as well.

The district has shown an increase in the amount of professional development provided to middle school teachers in the last several years. Continued district support of efforts such as the *Making Sense of Science* professional development partnership with the University of Wisconsin and WestEd (in San Francisco, CA) have proven very positive for increasing teacher knowledge. This has grown from our Title II B Math/Science Partnership grant, which ends in 2012-13.

Continuing and expanding this professional development would require funding after the grant ends. We will have trained facilitators in the district who will need to be reimbursed for facilitating the courses, and teachers who will need to be paid for their time to take them. We feel that new staff hired in the district would benefit greatly from participating in the courses as well as teachers who have been employed for many years. It might become an expectation for teachers to participate over time.

It is our responsibility to help our teachers feel successful in their science teaching and learning. We already have the tools that are necessary to do that. We need to commit to a systematic way of providing the professional development for our K-12 science teachers. We need support at the district level to provide time and funding to make this happen. Teachers do not necessarily come to us as prepared as they should be, but we have the resources to help them move forward. A current plan to improve teachers content knowledge and content literacy skills has been developed. It should be more broadly implemented by the 2013-14 school year.

Key Issue #4: Science Courses at the Secondary Level

The committee raised many concerns about the structure of courses at the high school level. The high failure rate, especially among students of color, is only one driving factor in the discussion.

With limited guidance, students do not necessarily take courses that prepare them for post-secondary options. It appears as though there are two paths through high school science – one route for those intending on attending an institute of higher education after high school, and one route for those who do not have these plans. Increasing the conversation with and knowledge of guidance staff at all schools regarding science programming will help change this for all students. With both the State of Wisconsin ESEA waiver and the Next Generation Science Standards pointing towards more science, broadening that option for students is important.

The Next Generation Science Standards call for increasing the depth of knowledge that all students have in science. This can only be accomplished when the district looks at all options for structuring the science program. As the district deepens its understanding of the Next Generation Science Standards, there will be opportunities to discuss new course configurations, structures and methods of supporting student learning. These discussions must include all options – as the emphasis continues to increase on science learning for all students.

After reviewing the soon to be released Next Generation Science Standards, an informed discussion and decision regarding a common 9th grade science course should occur with involvement of high school teachers from across the district.

Key Issue #5: Implementation of the Next Generation Science Standards

The implementation of the new, Next Generation Science Standards (NGSS) will provide an opportunity to deeply impact the way science is taught in MMSD. Several ideas that are found in the Foundation document have lead the committee to this conclusion: that science can no longer be taught in isolation as a separate content area, but rather strongly connected and integrated with all content areas. This means not only across typical science “boundaries” such as Biology, Chemistry, and Physics, but also crossing boundaries between content areas.

An example may be with Career and Technical Education. As engineering becomes one of the mainstays of science education, there will need to be a strong connection to the career pathways process that has been developed by the Career and Technical Education teachers. These pathways have been developed in combination with business partners across the United States. It is through deep collaboration and thinking more broadly about what is science that we will be able to provide the best education for all students as envisioned in the Next Generation Science Standards and documents that have been published over the past several years.

Chapter 11

K-12 Science Recommendations

The recommendations and action steps listed below are based on the knowledge gained through the Committee's study of the MMSD K-12 Science Program. Each of the 7 recommendations is rooted in data from our review; the major data components used to support the recommendation are given below each one. Below each recommendation are several actions steps which the committee said was critical to the achievement of the recommendation. While there are many actions steps given, this is neither exhaustive nor exclusive. As the Next Generation Science Standards are introduced, studied, and implemented in the district, there may be necessary changes to the direction of the recommendations. This document is designed to be a living, responsive set of recommendations, not static and stationary.

As each action step has an associated timeline with it and a budget listed where appropriate, these are to be considered guides. In cases where there are single actions which need to take place within a short timeframe, a single school year is listed. Where an action step is to be started in one school year, but then acted on over the following years, there will be the term "on-going" in the timeline box. No budget was extended past the 2012-13 school year, although some items were included based on known current costs. These will have to be reviewed on an annual basis.

The Responsible Personnel box provides guidance in not only who should be responsible, but who should be involved in the decision making process. Seldom is there a single person listed as responsible. The district should consider that we are all responsible for educating all students, therefore we should all take responsibility for that education… "every student achieving, everyone responsible" is a great way to think about this.

Finally, the committee wanted to add a box to help the reader visualize what success might look like after the timeline is complete. This box, while still containing broad descriptions, should provide at least one metric for action step success.

Recommendation 1: K-12 Alignment				
Define and implement a coherent, culturally relevant, consistent, and aligned K-12 Science curriculum.				
Findings to support recommendations are: • A Framework for K-12 Science Education • Next Generation Science Standards • Need for consistent curriculum • WKCE trends; decrease between Middle School and High School • Science Instructional Practices Survey Data				
Action Step	**Timeline**	**Responsible Personnel**	**Measure of Success**	**Budget/Resources Needed**
1.1 Develop K-12 Scope and Sequence; all curricula will be aligned with the Next Generation Science Standards and ACT College and Career Readiness Standards.	Semester 2, 2012-13	Assistant Director of Curriculum & Assessment, Doyle science staff, School-based science staff	K-12 Scope and Sequence will be completed; documents to indicate alignment to Next Generation Science Standards	25 teachers x 7 days x $220/sub = $22,000 District Facilitator
1.2 Develop Core Instructional Practices at each grade level to ensure that the full intent of the Next Generation Science Standards is being met (Scientific and Engineering Practices, Crosscutting Concepts and Core Ideas) for all students.	Begin in 2012-13, 2013-14	Doyle science staff, School-based science staff	Sequencing of content (K-8) will be determined	District Science budget (support of district science IRTs)

Recommendation 1: K-12 Alignment				
Define and implement a coherent, culturally relevant, consistent, and aligned K-12 Science curriculum.				
Findings to support recommendations are: • A Framework for K-12 Science Education • Next Generation Science Standards • Need for consistent curriculum • WKCE trends; decrease between Middle School and High School • Science Instructional Practices Survey Data				
Action Step	**Timeline**	**Responsible Personnel**	**Measure of Success**	**Budget/Resources Needed**
1.3 Align K-5 curriculum & content to ensure Align multiage classroom alternate year "A/B" content rotations across the district	2012-13	Doyle science staff, School-based science staff (K-5)	A consistent A/B rotation will be implemented across the district	District Scope and Sequence for Science Curricular Review of Learning Materials Funds 16 teachers x 2 sessions (half of elementary schools each time) x $110/sub = $3,520 [half-day subs]
1.4 Develop formative, benchmark, and summative student expectations aligned with Next Generation Science Standards; make this available via the MMSD Science Website	Begin in 2013-14, 2014-15	Doyle science staff, School-based science staff (K-5), Curriculum & Assessment web designer	Teachers will have student expectations available on the MMSD Science Website	District Science budget (support of district science IRTs)

Recommendation 1: K-12 Alignment				
Define and implement a coherent, culturally relevant, consistent, and aligned K-12 Science curriculum.				
Findings to support recommendations are: • A Framework for K-12 Science Education • Next Generation Science Standards • Need for consistent curriculum • WKCE trends; decrease between Middle School and High School • Science Instructional Practices Survey Data				
Action Step	**Timeline**	**Responsible Personnel**	**Measure of Success**	**Budget/Resources Needed**
1.5 Develop a consistent 9th grade course(s) and sequence based on Next Generation Science Standards Practices/ Cross-cutting concepts	Begin in 2013-14	Assistant Director of Curriculum & Assessment, Doyle science staff, School-based science staff (HS)	Course or courses will be determined that are equitable and based on Next Generation Science Standards Practices/Cross-cutting concepts; course sequencing complete	9 teachers (2 from each HS, 1 from Shabazz) x 3 days x \$220/sub = \$5,940 (support of district science IRTs)
1.6 Review and pilot materials for 9th grade course (s) through the Curricular Review of Learning Materials Review process	2013-14	Doyle science staff, School-based science staff (HS)	Materials list developed; Materials ordered	9 teachers x 8 hours x \$15 (extended employment) = \$1,080 Summer curriculum work 16 teachers x 20 hours x ext employment rate = approx. \$4,800

Recommendation 1: K-12 Alignment				
Define and implement a coherent, culturally relevant, consistent, and aligned K-12 Science curriculum.				
Findings to support recommendations are: • A Framework for K-12 Science Education • Next Generation Science Standards • Need for consistent curriculum • WKCE trends; decrease between Middle School and High School • Science Instructional Practices Survey Data				
Action Step	**Timeline**	**Responsible Personnel**	**Measure of Success**	**Budget/Resources Needed**
1.7 Implement 9th grade course(s)	2014-15	Doyle science staff, School-based science staff (HS)	Course(s) implemented at all 4 comprehensive HS.	Curricular Review of Learning Materials Funds: Material Costs To Be Determined
1.8 Determine a sequence of developmentally appropriate activities that meet the intent of the Next Generation Science Standards for Engineering Practices	2013-14, ongoing	Doyle science staff, School-based science staff, Assistant Director of Curriculum & Assessment	A framework of engineering activities by grade level will be developed	12 teachers (4 elementary, 4 middle, 4 high school) x 2 days x $220/sub = $5,280

Recommendation 2: Program & Practices
Implement and support a K-12 program that is based in the 8 areas of Scientific and Engineering Practice, culturally relevant, allows for place-based & community connections, uses data to improve, and uses the tools of science and provides for accountability in science instruction.
Findings to support recommendations are: • Fidelity of FOSS implementation and time for science • Science Material Center usage statistics • Access to informal science support • Underrepresentation of science instruction time in district sampling of Elementary Teacher schedules • Science Instructional Practices Survey Results

Action Step	Timeline	Responsible Personnel	Measure of Success	Budget/Resources Needed
2.1 Increase the number of required science credits for high school graduation	2012-13	Assistant Director of Curriculum & Assessment, Doyle science staff, Executive Director of Curriculum & Assessment, Superintendent, Board of Education	Students will be required to take 3 credits of science in order to graduate from High School	From current Doyle science budget (support of district science IRTs)

Recommendation 2: Program & Practices

Implement and support a K-12 program that is based in the 8 areas of Scientific and Engineering Practice, culturally relevant, allows for place-based & community connections, uses data to improve, and uses the tools of science and provides for accountability in science instruction.

Findings to support recommendations are:

- Fidelity of FOSS implementation and time for science
- Science Material Center usage statistics
- Access to informal science support
- Underrepresentation of science instruction time in district sampling of Elementary Teacher schedules
- Science Instructional Practices Survey Results

Action Step	Timeline	Responsible Personnel	Measure of Success	Budget/Resources Needed
2.2 Ensure alignment with the Wisconsin Department of Public Instruction minutes for elementary science instruction; work with Principals and Doyle-based administrators to develop an understanding of Department of Public Instruction recommended time for face-to-face science instruction	2011-12, 2012-13	Doyle science staff, Principals, Assistant Superintendents	Consistent message to teachers regarding number of required minutes; teacher schedules reflect required minutes	Assist. Supt newsletters

Recommendation 2: Program & Practices

Implement and support a K-12 program that is based in the 8 areas of Scientific and Engineering Practice, culturally relevant, allows for place-based & community connections, uses data to improve, and uses the tools of science and provides for accountability in science instruction.

Findings to support recommendations are:

- Fidelity of FOSS implementation and time for science
- Science Material Center usage statistics
- Access to informal science support
- Underrepresentation of science instruction time in district sampling of Elementary Teacher schedules
- Science Instructional Practices Survey Results

Action Step	Timeline	Responsible Personnel	Measure of Success	Budget/Resources Needed
2.3 Expand the Science Material Center during transition to new programming	2013-14, 2014-15, ongoing	Doyle science staff, Science Material Center technician	Transition plan is developed and implemented	To Be Determined
2.4 Increase Science Material Center Technician FTE	2013-14	Assistant Director of Curriculum & Assessment	Moving from 75% to 100%	Approx. $12,000 per year
2.5 Develop an inventory process to begin to catalog community connections	2012-13	Doyle science staff, Informal science community partners	Data base of providers developed and able to be accessed by district science leaders	From current Doyle science budget (support of district science IRTs)

Recommendation 2: Program & Practices				
Implement and support a K-12 program that is based in the 8 areas of Scientific and Engineering Practice, culturally relevant, allows for place-based & community connections, uses data to improve, and uses the tools of science and provides for accountability in science instruction.				
Findings to support recommendations are: • Fidelity of FOSS implementation and time for science • Science Material Center usage statistics • Access to informal science support • Underrepresentation of science instruction time in district sampling of Elementary Teacher schedules • Science Instructional Practices Survey Results				
Action Step	**Timeline**	**Responsible Personnel**	**Measure of Success**	**Budget/Resources Needed**
2.6 Develop web pages with community connections and appropriate program content on the MMSD Science web site	2012-13	Doyle science staff, Instructional Technology Staff, Curriculum & Assessment web designer	Web site will be functional by October 2012, up to date by March 2013	From current Doyle science budget (support of district science IRTs)
2.7 Develop a Science-Business Partnership (modeled after Career & Technical Education partnerships) in order to strengthen community connections to science education	2012-13, ongoing	Doyle science staff, community partners	Partnership developed between science educators and community groups interested in supporting science education	From current Doyle science budget (support of district science IRTs)

Recommendation 3: Intervention Systems (RtI2)				
Determine and implement consistent District-wide K-12 science intervention supports and programs so that all grades and schools have full access to Tier 2 and 3 level interventions that target early intervention and support for students.				
Findings to support recommendations are: • Lack of science assessments other than large-scale, standardized assessments. • Lack of science-specific, curricula-based teacher resources for differentiation • Lack of progress monitoring tools for science; pretesting students • Science Instructional Practices Survey Data				
Action Step	**Timeline**	**Responsible Personnel**	**Measure of Success**	**Budget/Resources Needed**
3.1 Ensure that formative, benchmark and summative assessments are aligned with district science program, Response to Instruction & Intervention	2013-14, ongoing	Doyle science staff, Assistant Director of Curriculum & Assessment, Director ESL/Bilingual, Science Leadership Teams, Diversity department	Assessments are tightly aligned with curricular interventions	From current Doyle science budget (support of district science IRTs)

Recommendation 3: Intervention Systems (RtI2)

Determine and implement consistent District-wide K-12 science intervention supports and programs so that all grades and schools have full access to Tier 2 and 3 level interventions that target early intervention and support for students.

Findings to support recommendations are:

- Lack of science assessments other than large-scale, standardized assessments.
- Lack of science-specific, curricula-based teacher resources for differentiation
- Lack of progress monitoring tools for science; pretesting students
- Science Instructional Practices Survey Data

Action Step	Timeline	Responsible Personnel	Measure of Success	Budget/Resources Needed
3.2 Identify and implement science specific programming options, interventions, and progress monitoring tools to support all learners achieve the highest levels in science.	2013-14, ongoing	Doyle science staff, Educational Services department, Diversity department, Talented and Gifted department	Classroom options, assessment, interventions, and resources are tightly aligned to content and curriculum that support Students with Disabilities, ELL students, TAG students and any student who is struggling with the science content.	National Science Teachers Association Framework (to review barriers to fully engaging all students in science) From current Doyle science budget (support of district science IRTs)

Recommendation 3: Intervention Systems (RtI2)				
Determine and implement consistent District-wide K-12 science intervention supports and programs so that all grades and schools have full access to Tier 2 and 3 level interventions that target early intervention and support for students.				
Findings to support recommendations are: • Lack of science assessments other than large-scale, standardized assessments. • Lack of science-specific, curricula-based teacher resources for differentiation • Lack of progress monitoring tools for science; pretesting students • Science Instructional Practices Survey Data				
Action Step	**Timeline**	**Responsible Personnel**	**Measure of Success**	**Budget/Resources Needed**
3.3 Develop and implement Professional Development to increase teacher knowledge and use of programming options, interventions, and progress monitoring tools for science.	2013-14, ongoing	Doyle science staff, Educational Services department, Diversity department, Talented and Gifted department	Professional Development offered for teachers at all levels, multiple times, formats	To be determined
3.4 Review current summer science programs to determine successes and needs; develop programs to respond to specific student populations in support of access to after school and summer programming.	2013-14, ongoing	Doyle science staff, School-based science staff, Talented and Gifted department, ESL/Bilingual/DLI department, Diversity department	Programs designed to meet student needs at multiple levels, engaging students in science activities outside typical school days/hours.	To be determined

Recommendation 3: Intervention Systems (RtI2)				
Determine and implement consistent District-wide K-12 science intervention supports and programs so that all grades and schools have full access to Tier 2 and 3 level interventions that target early intervention and support for students.				
Findings to support recommendations are: • Lack of science assessments other than large-scale, standardized assessments. • Lack of science-specific, curricula-based teacher resources for differentiation • Lack of progress monitoring tools for science; pretesting students • Science Instructional Practices Survey Data				
Action Step	**Timeline**	**Responsible Personnel**	**Measure of Success**	**Budget/Resources Needed**
3.5 Work with Educational Services to develop list of grade level appropriate science interventions, including appropriate assessments for district curricula	2013-14, ongoing	Doyle science staff, Educational Services department, ESL/Bilingual/DLI department, School-based science staff, Diversity department	Identification of interventions and assessments	12 teachers (4 elementary, 4 middle, 4 high school) x 2 days x $220/sub = $5,280

Recommendation 4: Instructional Materials				
Review and purchase science program instructional materials to achieve consistency and District-wide equity K-12				
Findings to support recommendations are: • K-12 Framework for Science Education • Next Generation Science Standards • Lack of science-specific curricular support materials in Spanish • Lack of alignment of certain modules to standards • Equity of materials within buildings/grades (replacement of old materials)				
Action Step	**Timeline**	**Responsible Personnel**	**Measure of Success**	**Budget/Resources Needed**
4.1 Identify and pilot high quality, engaging science material based upon the developed Scope & Sequence document and the Next Generation Science Standards. Ensure that both primary and secondary support material are in English and Spanish.	2013-14	Doyle science staff, School-based science staff	High quality curricular materials will be piloted and selected	To be determined
4.2 Develop a phased, prioritized K-12 implementation process for newly selected science learning materials	2013-14	Doyle science staff, School-based science staff	Implementation plan, including PD, will be developed and begun	Program Evaluation Curricular Review Cycle supports funding for this in 2013-14, 2014-15, and 2015-16

Recommendation 4: Instructional Materials				
Review and purchase science program instructional materials to achieve consistency and District-wide equity K-12				
Findings to support recommendations are: • K-12 Framework for Science Education • Next Generation Science Standards • Lack of science-specific curricular support materials in Spanish • Lack of alignment of certain modules to standards • Equity of materials within buildings/grades (replacement of old materials)				
Action Step	**Timeline**	**Responsible Personnel**	**Measure of Success**	**Budget/Resources Needed**
4.3 Purchase appropriate material through Curricular Review of Learning Materials Review process according to phased implementation plan	2013-14, 2014-15, 2015-16	Doyle science staff, School-based science staff	Material incorporated within scope and sequence	Program Evaluation Curricular Review Cycle supports funding for this in 2013-14, 2014-15, and 2015-16
4.4 Increase non-fiction reading resources that align to district supported Science curricula, at different reading levels.	2013-14, ongoing	Doyle science staff, School-based science staff	Schools will be provided additional non-fiction resources that are aligned to the district supported Science curricula to support instruction	Program Evaluation Curricular Review Cycle supports funding for this in 2013-14 and 2014-15
4.5 Increase the inclusion of sustainability concepts in appropriate science units.	2013-14, ongoing	Doyle science staff, School-based science staff, Assistant Director of Curriculum & Assessment	Concepts of sustainability will be taught in all grades, as appropriate for student developmental level and content topics	Web site resources, print resources available

Recommendation 4: Instructional Materials				
Review and purchase science program instructional materials to achieve consistency and District-wide equity K-12				
Findings to support recommendations are: • K-12 Framework for Science Education • Next Generation Science Standards • Lack of science-specific curricular support materials in Spanish • Lack of alignment of certain modules to standards • Equity of materials within buildings/grades (replacement of old materials)				
Action Step	**Timeline**	**Responsible Personnel**	**Measure of Success**	**Budget/Resources Needed**
4.6 Incorporate sustainability concepts into common science assessments	2014-15, ongoing	Doyle science staff, School-based science staff, Assistant Director of Curriculum & Assessment	Science Common assessments will include concepts of sustainability, as appropriate, in the questions for students. These assessments could take multiple forms.	Substitutes for teacher development of common assessments, to be determined.
4.7 Develop a list of facility needs for science at each high school.	2012-13, ongoing	Doyle science staff, School-based science staff, Assistant Director of Curriculum & Assessment	Determine what facility upgrades will be needed to implement programs aligned with the new standards	To be determined

Recommendation 5: Accountability System				
Implementation of a science assessment process and use of data to drive program improvement				
Findings to support recommendations are: • Current heavy reliance upon WKCE to gather district science data • Lack of large-scale, nationally normed, standardized assessments for Science at K-7 • Lack of assessments that show growth/progress in Science at K-7				
Action Step	**Timeline**	**Responsible Personnel**	**Measure of Success**	**Budget/Resources Needed**
5.1 Implement a comprehensive science assessment system which will provide data to improve classroom instruction; focus on grade levels without current standardized science assessments (3, 5, 6, 7th grades)	2013-14, ongoing	Assistant Director of Curriculum & Assessment, Doyle science staff, School-based science staff	Increased availability of science data 3-12, other than WKCE	To Be Determined
5.2 Develop common summative assessments at the high school level	2013-14, 2014-15, 2015-16, ongoing	Doyle science staff, School-based science staff	Develop common assessments at the unit level for common courses	8 teachers x 2 days x $220/sub = $3,520 annually, 3 years
5.3 Develop/Identify common protocols for understanding science data across district	2012-13, ongoing	Doyle science staff, school level science leaders	Teachers across the district will have common talking points regarding science test data	From current Doyle science budget (support of district science IRTs)

Recommendation 6: Specialized Staff				
Work to provide students with science staff that reflect the cultural diversity of the district				
Findings to support recommendations are: • Need for consistency in position (remain at specific grade-level) • Need for content specialists (Instructional Resource Teachers) at Elementary • Need for content specialists/certification at MS				
Action Step	**Timeline**	**Responsible Personnel**	**Measure of Success**	**Budget/Resources Needed**
6.1 With Human Resources, develop an updated interview tool to help principals hire knowledgeable science teachers at all grade levels	2013-14, ongoing	Doyle science staff	Rubric used to help with elementary, middle, and high school hiring. Hire teachers with cultural competence with respect to science instruction	From current Doyle science budget (support of district science IRTs)
6.2 Work with principals to develop an understanding of the expertise needed to teach science well, encourage longevity in positions	2012-13, ongoing	Doyle science staff	Fewer teachers will be moved out of science positions by principals each year	From current Doyle science budget (support of district science IRTs)
6.3 Work with Human Resources and principals to increase the number of science teachers of color in the district.	2012-13, ongoing	Assistant Director of Curriculum & Assessment	More teachers of color will apply for, interview, and be hired for science teaching positions	Current resources

Recommendation 7: Professional Development

Establish a comprehensive and flexible science professional development model that includes online learning opportunities to optimize all instructional staff and administrator participation in science professional development.

Findings to support recommendations are:

- Lack of district-sponsored professional development at all grade levels
- Title IIB Grant Data (to support Making Sense of Science Professional Development)
- Science Instructional Practices Survey Data

Action Step	Timeline	Responsible Personnel	Measure of Success	Budget/Resources Needed
7.1 Develop online Professional Development about each curricular unit at each grade level	2013-14, ongoing	Doyle science staff	Annually, at least one unit per grade level (K-8) will be added to the online Professional Development bank until all are represented	To Be Determined
7.2 Develop and provide Professional Development for New Educators in District	2013-14, ongoing	Doyle science staff	Professional Development will be offered prior to school year at New Educator Support Course training and throughout school-year as appropriate	From current Doyle science resources; IRT time

Recommendation 7: Professional Development				
Establish a comprehensive and flexible science professional development model that includes online learning opportunities to optimize all instructional staff and administrator participation in science professional development.				
Findings to support recommendations are: • Lack of district-sponsored professional development at all grade levels • Title IIB Grant Data (to support Making Sense of Science Professional Development) • Science Instructional Practices Survey Data				
Action Step	**Timeline**	**Responsible Personnel**	**Measure of Success**	**Budget/Resources Needed**
7.3 Provide Professional Development in the Next Generation Science Standards, their meaning for instruction, and their implementation	2012-13, 2013-14, ongoing	Doyle science staff	All District staff involved in science instruction will have access to and develop an understanding of the Next Generation Science Standards as well as classroom applications	To be determined
7.4 In collaboration with the Professional Development department, develop and implement Science Professional Development for building based leadership	Begin in 2012-13, ongoing	Doyle science staff, Professional Development department	Principals, Instructional Resource Teachers and Learning Coordinators will understand the classroom implications of the Next Generation Science Standards	From current Doyle science budget (support of district science IRTs)

Recommendation 7: Professional Development				
Establish a comprehensive and flexible science professional development model that includes online learning opportunities to optimize all instructional staff and administrator participation in science professional development.				
Findings to support recommendations are: • Lack of district-sponsored professional development at all grade levels • Title IIB Grant Data (to support Making Sense of Science Professional Development) • Science Instructional Practices Survey Data				
Action Step	**Timeline**	**Responsible Personnel**	**Measure of Success**	**Budget/Resources Needed**
7.5 Coordinate Professional Development across levels and content (district-wide), in collaboration with the Professional Development department	Begin in 2012-13, ongoing	Doyle science staff, Professional Development department	Professional Development will be consistent and coordinated; opportunities for Professional Development between feeder schools, across schools at similar grade levels, etc.	From current Doyle science budget (support of district science IRTs)
7.6 Develop and implement technology-based Professional Development (at all levels), in collaboration with the Professional Development department	Begin in 2013-14, ongoing	Doyle science staff, Professional Development department	Professional Development will be consistent, meaningful, and based in classroom practice; when appropriate Professional Development will be put on website	From current Doyle science budget (support of district science IRTs)

Recommendation 7: Professional Development				
Establish a comprehensive and flexible science professional development model that includes online learning opportunities to optimize all instructional staff and administrator participation in science professional development.				
Findings to support recommendations are: • Lack of district-sponsored professional development at all grade levels • Title IIB Grant Data (to support Making Sense of Science Professional Development) • Science Instructional Practices Survey Data				
Action Step	**Timeline**	**Responsible Personnel**	**Measure of Success**	**Budget/Resources Needed**
7.7 Develop instructional leadership at each level to support curricular implementation, provide feedback from schools, and provide guidance for district level implementation of the Next Generation Science Standards (elementary and middle school levels)	2013-14, ongoing	Doyle science staff, School-based science staff	Allow for leaders to provide feedback and direction regarding science program	16 teachers x 2 sessions (half of elementary schools each time) x $220/sub =$7,040 12 MS teachers x 2 sessions x $220/sub = $2640
7.8 Implement science safety Professional Development specific to each grade level and high school course area	Begin in 2012-13, ongoing	Doyle science staff	All science teachers will receive safety Professional Development annually, through various formats	To Be Determined

Recommendation 7: Professional Development				
Establish a comprehensive and flexible science professional development model that includes online learning opportunities to optimize all instructional staff and administrator participation in science professional development.				
Findings to support recommendations are: • Lack of district-sponsored professional development at all grade levels • Title IIB Grant Data (to support Making Sense of Science Professional Development) • Science Instructional Practices Survey Data				
Action Step	**Timeline**	**Responsible Personnel**	**Measure of Success**	**Budget/Resources Needed**
7.9 Develop and implement professional development around science-specific interventions and assessments	Begin in 2013-14, ongoing	Doyle science staff, Educational Services staff	Implementation of Professional Development regarding interventions and assessments	To Be Determined
7.10 Develop and implement professional development to use test data to improve science instruction for all students	Begin in 2013-14, ongoing	Doyle science staff, School-based science staff, Educational Services staff, Talented and Gifted staff	Test data will be used by classroom teachers to improve instruction	To Be Determined

Tentative Budget Implications

Year	Approximate Budget amounts contained within recommendations
2012-2013	$25,520 – to come from current science budgeted amount
2013-2014	Approx. $50,000 above current levels
2014-2015	To be determined
2015-2016	To be determined

Chapter 12

Conclusions: Continuous Improvement and Learning

The report is designed to serve as a map for improvement of the science program of the district. This document is a step in the direction of change. It is asking for a commitment of the district to the education of the whole child, every child. It requires change.

Indeed, we are living in a time of great societal and global change. We are seeing this on many levels: locally, nationally and globally. As the District works with new focus on closing the achievement gap and increasing literacy levels, the entire nature of the Madison community is changing. At such a time, it is too easy to focus on a few issues without looking at the entire picture of how each content area supports the entire learning process of a child.

We also are in the midst of changing the science education standards within the state and nation. From the basic changes that bring engineering into the science domain to the more subtle, yet powerful changes in the Scientific Practices, the learning curve will be steep. It will require planning and professional development, time for teacher and for administrators to learn and understand the new expectations, and finally a new approach to how science education is delivered to students in the district.

The District needs to embrace the Next Generation Science Standards and the significant change in science education that they will bring. This will not be a process of change that is completed in a short timeframe; rather it will require a deep foundational change in the way that science is taught. This uncertainty should be viewed as a opportunity for action on program improvement rather than a reason for inaction. It is during times of transition that the greatest changes can be implemented. Many conversations, much learning, and decisive action must take place in order for this to happen.

Cross-content area learning needs to become the way of doing business. The science program can provide the context for why students need to read well, write clearly, and calculate correctly. Each content area, while important in its own right, needs the others in order to provide students with a learning environment and skills that reflects the world of their future.

In order to attain the goals set forth in this report, everyone involved in educating the students of the Madison Metropolitan School District needs to work continuously to improve the learning process for our students. This includes everyone: from teachers and classroom aides, to administrators and professional developer, to our many community partners. With this dedication to the concept of “we can always improve”, our District not only will close the achievement gap, but also provide an example of what can be done when dedicated, passionate people work together for the benefit of our community’s children.

APPENDIX A

Science Program Review Committee Membership

Melissa Braaten	Mike Merline
Mary Brand	Emily Miller
Susan Cohen	Kevin Niemi
Andreal Davis	Nathan O'Shaughnessy
Anu Ebbe	Tim Peterson
Randy Eide	Lori Schacht DeThorne
Kay Enright	Amy Schiebel
Kathy Huncosky	Clare Seguin
Sara Huse	Andrew Statz
Kyle Jenson	Miles Tolkheim
Carmen Lombard	Lisa Wachtel

APPENDIX C

Current Practices Survey – Elementary, Middle School, High School

Science Program Review 2011-2012

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Science Program Review 2011-2012

Page 1 - Question 1 - Choice - Multiple Answers (Bullets) [Mandatory] [Up To 3 Answers]

Please select the grade band you taught science instruction to during the 2010-11 school year.

- ❑ K-5 [Skip to 2]
- ❑ 6-8 [Skip to 3]
- ❑ 9-12 [Skip to 4]

Page 2 - Question 2 - Choice - Multiple Answers (Bullets) [Mandatory] [Up To 6 Answers]

Please select the specific grade(s) you taught science instruction to during the 2010-2011 school year.

- ❑ K [Skip to 5]
- ❑ 1 [Skip to 5]
- ❑ 2 [Skip to 5]
- ❑ 3 [Skip to 6]
- ❑ 4 [Skip to 6]
- ❑ 5 [Skip to 6]

Page 3 - Question 3 - Choice - Multiple Answers (Bullets) [Mandatory] [Up To 3 Answers]

Please select the specific grade(s) you taught science instruction to during the 2010-2011 school year.

- ❑ 6 [Skip to 7]
- ❑ 7 [Skip to 7]
- ❑ 8 [Skip to 7]

Page 4 - Question 4 - Choice - Multiple Answers (Bullets) [Mandatory] [Up To 4 Answers]

Please select the specific grade(s) you taught science instruction to during the 2010-2011 school year.

- ❑ 9 [Skip to 8]
- ❑ 10 [Skip to 8]
- ❑ 11 [Skip to 8]
- ❑ 12 [Skip to 8]

Page 5 - Question 5 - Choice - Multiple Answers (Bullets) [Mandatory] [Up To 3 Answers]

Please select the school you taught in during the 2010-2011 school year.

- ❑ Allis [Skip to 9]
- ❑ Chavez [Skip to 9]
- ❑ Crestwood [Skip to 9]
- ❑ Elvehjem [Skip to 9]
- ❑ Emerson [Skip to 9]
- ❑ Falk [Skip to 9]
- ❑ Franklin [Skip to 9]
- ❑ Glendale [Skip to 9]
- ❑ Gompers [Skip to 9]
- ❑ Hawthorne [Skip to 9]
- ❑ Huegel [Skip to 9]
- ❑ Kennedy [Skip to 9]
- ❑ Lake View [Skip to 9]
- ❑ Lapham [Skip to 9]
- ❑ Leopold [Skip to 9]
- ❑ Lindbergh [Skip to 9]
- ❑ Lowell [Skip to 9]
- ❑ Mendota [Skip to 9]
- ❑ Midvale [Skip to 9]
- ❑ Muir [Skip to 9]
- ❑ Nuestro Mundo [Skip to 9]
- ❑ Olson [Skip to 9]
- ❑ Orchard Ridge [Skip to 9]
- ❑ Sandberg [Skip to 9]
- ❑ Schenk [Skip to 9]
- ❑ Shorewood [Skip to 9]
- ❑ Stephens [Skip to 9]
- ❑ Thoreau [Skip to 9]
- ❑ Van Hise [Skip to 9]

Page 6 - Question 6 - Choice - Multiple Answers (Bullets) [Mandatory] [Up To 3 Answers]

Please select the school you taught in during the 2010-2011 school year.

- ❑ Allis [Skip to 10]
- ❑ Chavez [Skip to 10]
- ❑ Crestwood [Skip to 10]
- ❑ Elvehjem [Skip to 10]
- ❑ Emerson [Skip to 10]
- ❑ Falk [Skip to 10]
- ❑ Glendale [Skip to 10]
- ❑ Gompers [Skip to 10]
- ❑ Hawthorne [Skip to 10]
- ❑ Huegel [Skip to 10]
- ❑ Kennedy [Skip to 10]
- ❑ Lake View [Skip to 10]
- ❑ Leopold [Skip to 10]
- ❑ Lincoln [Skip to 10]
- ❑ Lindbergh [Skip to 10]
- ❑ Lowell [Skip to 10]

- ❑ Marquette [Skip to 10]
- ❑ Mendota [Skip to 10]
- ❑ Muir [Skip to 10]
- ❑ Nuestro Mundo [Skip to 10]
- ❑ Olson [Skip to 10]
- ❑ Orchard Ridge [Skip to 10]
- ❑ Randall [Skip to 10]
- ❑ Sandberg [Skip to 10]
- ❑ Schenk [Skip to 10]
- ❑ Shorewood [Skip to 10]
- ❑ Stephens [Skip to 10]
- ❑ Thoreau [Skip to 10]
- ❑ Van Hise [Skip to 10]

Page 7 - Question 7 - Choice - One Answer (Bullets) [Mandatory]

Please select the school you taught at during the 2010-11 school year.

- ❍ Black Hawk [Skip to 11]
- ❍ Cherokee [Skip to 11]
- ❍ Hamilton [Skip to 11]
- ❍ Jefferson [Skip to 11]
- ❍ O'Keeffe [Skip to 11]
- ❍ Sennett [Skip to 11]
- ❍ Sherman [Skip to 11]
- ❍ Spring Harbor [Skip to 11]
- ❍ Toki [Skip to 11]
- ❍ Whitehorse [Skip to 11]
- ❍ Wright [Skip to 11]

Page 8 - Question 8 - Choice - One Answer (Bullets) [Mandatory]

Please select the school you taught at during the 2010-11 school year.

- ❍ East [Skip to 13]
- ❍ LaFollette [Skip to 13]
- ❍ Memorial [Skip to 13]
- ❍ Shabazz [Skip to 13]
- ❍ West [Skip to 13]

Page 9 - Question 9 - Choice - Multiple Answers (Bullets) [Mandatory]

Please select the module(s) you taught during the 2010-11 school year.

- ❑ Grade K-1: Wood & Paper
- ❑ Grade K-1: Fabric
- ❑ Grade K-1: Analyzing Animals Immersion Unit
- ❑ Grade K-1: Trees
- ❑ Grade K-1: Balance & Motion
- ❑ Grade K-1: Pebbles, Sand, & Silt
- ❑ Grade K-1: New Plants
- ❑ Grades 2-3: Solids & Liquids
- ❑ Grades 2-3: Air & Weather
- ❑ Grades 2-3: Insects (w/MMSD modifications)

- ❑ Grades 2-3: Physics of Sound
- ❑ Grades 2-3: Earth Materials
- ❑ Grades 2-3: Investigating Responses Immersion Unit w/FOSS Structures of Life

Page 9 - Question 10 - Choice - Multiple Answers (Bullets) [Mandatory] [Up To 14 Answers]

Of the modules you used during the 2010-11 school year, please select those in which you covered less than 50% of the material.

- ❑ I covered more than 50% of the material in all the modules I taught. [Skip to 12]
- ❑ Grade K-1: Wood & Paper [Skip to 12]
- ❑ Grade K-1: Fabric [Skip to 12]
- ❑ Grade K-1: Analyzing Animals Immersion Unit [Skip to 12]
- ❑ Grade K-1: Trees [Skip to 12]
- ❑ Grade K-1: Balance & Motion [Skip to 12]
- ❑ Grade K-1: Pebbles, Sand, & Silt [Skip to 12]
- ❑ Grade K-1: New Plants [Skip to 12]
- ❑ Grades 2-3: Solids & Liquids [Skip to 12]
- ❑ Grades 2-3: Air & Weather [Skip to 12]
- ❑ Grades 2-3: Insects (w/MMSD modifications) [Skip to 12]
- ❑ Grades 2-3: Physics of Sound [Skip to 12]
- ❑ Grades 2-3: Earth Materials [Skip to 12]
- ❑ Grades 2-3: Investigating Responses Immersion Unit w/FOSS Structures of Life [Skip to 12]

Page 10 - Question 11 - Choice - Multiple Answers (Bullets) [Mandatory]

Please select the module(s) you taught during the 2010-11 school year.

- ❑ Grade 2-3: Solids & Liquids
- ❑ Grade 2-3: Air & Weather
- ❑ Grade 2-3: Insects (w/MMSD modifications)
- ❑ Grade 2-3: Physics of Sound
- ❑ Grade 2-3: Earth Materials
- ❑ Grade 2-3: Investigating Responses Immersion Unit w/FOSS Structures of Life
- ❑ Grades 4-5: Magnetism & Electricity
- ❑ Grades 4-5: Water
- ❑ Grades 4-5: Microworlds
- ❑ Grades 4-5: Mixtures & Solutions
- ❑ Grades 4-5: Landforms (w/MMSD modifications)
- ❑ Grades 4-5: Environments (w/MMSD modifications)
- ❑ Grades 4-5: Variables

Page 10 - Question 12 - Choice - Multiple Answers (Bullets) [Mandatory] [Up To 14 Answers]

Of the modules you used during the 2010-11 school year, please select those in which you covered less than 50% of the material.

- ❑ I covered more than 50% of the material in all the modules I taught. [Skip to 12]
- ❑ Grade 2-3: Solids & Liquids [Skip to 12]
- ❑ Grade 2-3: Air & Weather [Skip to 12]
- ❑ Grade 2-3: Insects (w/MMSD modifications) [Skip to 12]
- ❑ Grade 2-3: Physics of Sound [Skip to 12]
- ❑ Grade 2-3: Earth Materials [Skip to 12]
- ❑ Grade 2-3: Investigating Responses Immersion Unit w/FOSS Structures of Life [Skip to 12]

- ❑ Grades 4-5: Magnetism & Electricity [Skip to 12]
- ❑ Grades 4-5: Water [Skip to 12]
- ❑ Grades 4-5: Microworlds [Skip to 12]
- ❑ Grades 4-5: Mixtures & Solutions [Skip to 12]
- ❑ Grades 4-5: Landforms (w/MMSD modifications) [Skip to 12]
- ❑ Grades 4-5: Environments (w/MMSD modifications) [Skip to 12]
- ❑ Grades 4-5: Variables [Skip to 12]

Page 11 - Question 13 - Choice - Multiple Answers (Bullets) [Mandatory]

Please select the module(s) you taught during the 2010-11 school year.

- ❑ Grade 6-7-8: Force & Motion
- ❑ Grade 6-7-8: Weather & Water
- ❑ Grade 6-7-8: Diversity of Life (w/Investigating Diversity of Life Immersion Unit)
- ❑ Grade 6-7-8: Chemical Interactions
- ❑ Grade 6-7-8: Exploring Earth's Landforms Immersion Unit w/FOSS Earth History
- ❑ Grade 6-7-8: Populations & Ecosystems
- ❑ Grade 6-7-8: Electronics
- ❑ Grade 6-7-8: Electrical Alarm System Immersion Unit
- ❑ Grade 6-7-8: Planetary Science
- ❑ Grade 6-7-8: Human Brain & Senses

Page 11 - Question 14 - Choice - Multiple Answers (Bullets) [Mandatory]

Of the modules you used during the 2010-11 school year, please select those in which you covered less than 50% of the material.

- ❑ I covered more than 50% of the material in all the modules I taught.
- ❑ Grade 6-7-8: Force & Motion
- ❑ Grade 6-7-8: Weather & Water
- ❑ Grade 6-7-8: Diversity of Life (w/Investigating Diversity of Life Immersion Unit)
- ❑ Grade 6-7-8: Chemical Interactions
- ❑ Grade 6-7-8: Exploring Earth's Landforms Immersion Unit w/FOSS Earth History
- ❑ Grade 6-7-8: Populations & Ecosystems
- ❑ Grade 6-7-8: Electronics
- ❑ Grade 6-7-8: Electrical Alarm System Immersion Unit
- ❑ Grade 6-7-8: Planetary Science
- ❑ Grade 6-7-8: Human Brain & Senses

Page 12 - Question 15 - Choice - Multiple Answers (Bullets) [Mandatory] [Up To 6 Answers]

In the 2010-2011 school year, if you did not teach the district recommended investigations for each FOSS/STC module, please indicate why (select all that apply).

- ❑ I only used FOSS/STC materials
- ❑ Time limitations
- ❑ I used other materials I thought were better
- ❑ Materials are not at an appropriate instructional level
- ❑ Materials do not address standards
- ❑ Need additional PD around FOSS/STC content
- ❑ Other, please specify

Page 12 - Question 16 - Choice - Multiple Answers (Bullets) [Mandatory] [Up To 6 Answers]

Please indicate the type(s) of additional materials you used in your science instruction during the 2010-11 school year (select all that apply).

- ❑ I didn't use any additional materials
- ❑ Other textbooks
- ❑ Scholarly science articles/science news magazines/non-fiction books
- ❑ Additional curriculum materials from other publishers or self-created materials
- ❑ Internet resources
- ❑ Fiction texts/novels

Page 12 - Question 17 - Choice - One Answer (Bullets) [Mandatory]

Do you access materials through the Science Materials Center (SMC)?

- ❍ Yes [Skip to 15]
- ❍ No [Skip to 15]
- ❍ I don't know what the Science Materials Center is. [Skip to 15]
- ❍ I don't, but someone else from my building orders for me through the SMC. [Skip to 15]

Page 13 - Question 18 - Choice - Multiple Answers (Bullets) [Up To 42 Answers]

Please select the course(s) that you taught during the 2010-11 school year:

- ❑ Advanced Biology
- ❑ Advanced Chemistry
- ❑ AP Chemistry
- ❑ Advanced Science & Engineering
- ❑ Anatomy & Physiology (Advanced Biology 2)
- ❑ Astronomy
- ❑ Astrophysics (Advanced Astronomy and Astrophysics)
- ❑ Biology (General, 1, I)
- ❑ Biology 2
- ❑ Biology AP
- ❑ Biology Honors (Accelerated, Embedded)
- ❑ Biotechnology
- ❑ Chemistry (Math Chemistry)
- ❑ Chemistry Honors (Honors Math Chemistry)
- ❑ Conceptual Chemistry
- ❑ Conceptual Physics
- ❑ Conservation Biology
- ❑ Earth Science 1
- ❑ Earth Science 2
- ❑ Environmental Science AP
- ❑ Forensic Science
- ❑ Fundamentals of Biology
- ❑ General Chemistry (Chem-Com)
- ❑ General Physics
- ❑ Geology
- ❑ Geology Honors
- ❑ Integrated Science
- ❑ Limnology & Oceanography
- ❑ Limnology & Oceanography Honors (Embedded)

- ❑ Math Physics (Accelerated Math Physics)
- ❑ Math Physics 2 (Advanced Physics)
- ❑ Mechanical World
- ❑ Meteorology
- ❑ Physical Science
- ❑ Physics B AP
- ❑ Physics C Mechanics AP
- ❑ Physics Honors
- ❑ PLTW-Aerospace Engineering
- ❑ PLTW-Biomedical Innovations
- ❑ PLTW-Human Body Systems
- ❑ PLTW-Medical Interventions
- ❑ PLTW-Principles of Biomedical Sciences
- ❑ Other, please specify

Page 14 - Question 19 - Open Ended - Comments Box

Thinking about the primary science course that you taught during the 2010-11 school year, please indicate the title, author, publisher, and publication year of the textbook you used.

Page 14 - Question 20 - Choice - One Answer (Bullets)

In considering the primary course you taught during the 2010-11 school year, how was your science textbook used?

- ❍ As the primary tool for instruction
- ❍ As a supplementary tool for instruction
- ❍ The textbook was rarely used in my classroom
- ❍ I didn't use a textbook

Page 14 - Question 21 - Choice - Multiple Answers (Bullets) [Up To 6 Answers]

Please indicate the type(s) of additional materials you used in your science instruction during the 2010-11 school year (select all that apply).

- ❑ I didn't use any additional materials
- ❑ Other textbooks
- ❑ Scholarly science articles/science news magazines/non-fiction books
- ❑ Additional curriculum materials from other publishers or self-created materials
- ❑ Internet resources
- ❑ Fiction texts/novels

Page 15 - Question 22 - Rating Scale - Matrix

How often do you reference and use the following?

	Never	Rarely (e.g., a few times a year)	Sometimes (e.g., once or twice a month)	Often (e.g., once or twice a week)	All or almost all the time (e.g., daily)
National Science Education Standards?	❍	❍	❍	❍	❍
WI Model Academic Standards (K-12)	❍	❍	❍	❍	❍
MMSD Standards (K-8)	❍	❍	❍	❍	❍

Page 15 - Question 23 - Rating Scale - Matrix

In your science instruction, how often do you:

	Never	25% of the time	50% of the time	75% of the time	100% of the time	N/A
Pretest your students at the beginning of each new unit	❍	❍	❍	❍	❍	❍
Use formative assessments	❍	❍	❍	❍	❍	❍
Use summative assessments	❍	❍	❍	❍	❍	❍
Use student data to make changes in your instructional program	❍	❍	❍	❍	❍	❍

Page 15 - Question 24 - Rating Scale - Matrix

How often do students engage in the following practices in your classroom?

	Never	Rarely (e.g., a few times a year)	Sometimes (e.g., once or twice a month)	Often (e.g., once or twice a week)	All or almost all the time (e.g., daily)
Ask questions	❍	❍	❍	❍	❍
Develop and use models	❍	❍	❍	❍	❍
Plan and carry out investigations	❍	❍	❍	❍	❍
Interpret & analyze data	❍	❍	❍	❍	❍
Use mathematics, information & computer technology, & computational thinking	❍	❍	❍	❍	❍
Construct explanations	❍	❍	❍	❍	❍
Engage in argument from evidence	❍	❍	❍	❍	❍
Communicate information formally	❍	❍	❍	❍	❍

Page 16 - Question 25 - Rating Scale - Matrix

Within your classroom practices for science instruction, how often do you allow for the following:

	Never	Rarely (e.g., a few times a year)	Sometimes (e.g., once or twice a month)	Often (e.g., once or twice a week)	All or almost all the time (e.g., daily)
Individual work	❍	❍	❍	❍	❍

Small group work	○	○	○	○	○
Flexible grouping	○	○	○	○	○
Whole group work	○	○	○	○	○
Demonstrations	○	○	○	○	○
Discussions	○	○	○	○	○
Formal presentations	○	○	○	○	○

Page 16 - Question 26 - Rating Scale - Matrix

Do you access any of the following locations in addition to your classroom for science instruction?

	Yes	No
Schoolyard	○	○
School Forest	○	○
Cherokee Marsh	○	○
Planetarium	○	○
City Parks	○	○

Page 17 - Question 27 - Rating Scale - Matrix

Within your classroom practices for science instruction, how often do you:

	Never	Rarely (e.g., a few times a year)	Sometimes (e.g., once or twice a month)	Often (e.g., once or twice a week)	All or almost all the time (e.g., daily)
Ask higher order thinking questions (open ended)	○	○	○	○	○
Allow students to work at their own pace	○	○	○	○	○
Make connections between science and other disciplines	○	○	○	○	○
Provide different amounts of time for students to complete the same task	○	○	○	○	○
Connect academic content to students' cultural heritage, current events, or daily lives	○	○	○	○	○
Connect academic content to outdoor learning environments	○	○	○	○	○

Page 17 - Question 28 - Rating Scale - Matrix

Within your classroom practices for science instruction, how often do you:

	Never	Rarely (e.g., a few times a year)	Sometimes (e.g., once or twice a month)	Often (e.g., once or twice a week)	All or almost all the time (e.g., daily)
Have students use different processes or activities that address the same standard, lesson, or objective	○	○	○	○	○
Have students use different content to address the same standard, lesson, or objective	○	○	○	○	○

Have students demonstrate their understanding through a variety of products (i.e., orally, in writing, via performance, product creating, etc.)	❍	❍	❍	❍	❍

Page 18 - Question 29 - Rating Scale - Matrix

In regards to teaching science, do you ever:

	Y e s	N o
Collaborate with other science teachers around instruction and/or student work in science?	❍	❍
Collaborate with an instructional team around science and/or student work in science (ELL, Sped, SES, AVID, Literacy coach, etc.)?	❍	❍
Collaborate with school leadership teams around science and/or student work in science?	❍	❍

Page 18 - Question 30 - Rating Scale - Matrix

In the past 3 years, have you:

	Yes	No
Taken formal courses in science/science teaching?	❍	❍
Attended or led PD/conferences/workshops for science?	❍	❍
Received any local, state, or national grants or awards for science teaching?	❍	❍
Served in a science leadership position?	❍	❍

Thank You Page

Standard

Screen Out Page

Standard

Over Quota Page

Standard

Survey Closed Page

Standard