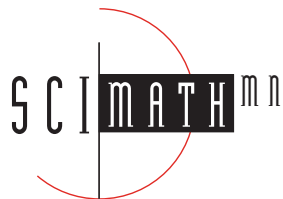


Minnesota K-12 **Mathematics Framework**

Supporting standards-based mathematics education
for all Minnesota students



Founded in 1993, SciMath^{MN} is a partnership among education, business, and state government to pursue statewide improvement in the teaching and learning of K-12 mathematics and science based on the national mathematics and science education standards and the *Minnesota Graduation Standards*. SciMath^{MN}'s vision is to increase the educational achievement and participation of all Minnesota students in science and mathematics to help them meet the complex challenges of their future. Efforts are focused in three areas: Policy - advancing state and institutional policies that promote mathematical and scientific literacy for all students; Public Awareness - increasing public knowledge and support for high standards and the importance of quality mathematics and science education for all students; and Professional Development - strengthening the preparation of new teachers and expanding the knowledge and skills of practicing teachers.

The Minnesota K-12 Mathematics Framework was developed with funding from the Minnesota Legislature, significant contributions from the Minnesota Department of Children, Families & Learning, and the generosity of Honeywell, Inc.

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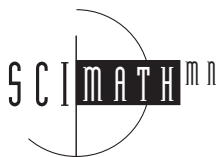
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Graduation Standards are current as of December 8, 1997. Consult the MN Department of Children, Families & Learning web page at <http://cfl.state.mn.us>, check with your MEEP regional coordinator, or call 612.296.1447 for updates.

Permission is granted to duplicate these materials for nonprofit purposes when proper credit is given. This publication will be available electronically at <http://www.informns.k12.mn.us/scimathmn>

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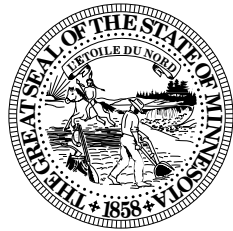
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Preface

Soon after it was formed in 1993 as a statewide coalition for standards-based reform for K-12 science and mathematics education in Minnesota, SciMath^{MN} began a multi-year effort to write and produce state curriculum frameworks. The standards movement had already made inroads across the country, and in Minnesota a new scheme of performance-based high school graduation requirements was taking shape in the form of curriculum standards. The idea was to identify a common set of core concepts and skills which every Minnesota graduate should master. In science and mathematics, the Minnesota standards quickly came to reflect the content of the national curriculum standards. What was missing, however, was a document to identify the powerful overlap of national and state standards and to help educators translate those ideas into their own instructional practice.

Thus, the *Minnesota K-12 Mathematics Framework* produced by SciMath^{MN} in cooperation with the Minnesota Department of Children, Families & Learning is about standards and about connections. Working from the premise that having common standards and a coherent mathematics program statewide will lead to improved student performance, the *Minnesota K-12 Mathematics Framework* builds on the state standards to define the mathematics content that all students should know and be able to do. The framework deliberately and graphically illustrates the connections between the national and state standards in mathematics, showing the ways in which the key concepts of the standards can be translated into mathematics programs at the district, school, and classroom levels.

This framework is also about connecting mathematics content to instruction and assessment. Reflecting the importance of inquiry and problem solving in the *Minnesota Graduation Standards* overall, the *Minnesota K-12 Mathematics Framework* focuses on the notion that learning mathematics is an active process and that this emphasis on active learning should guide our choices of instructional strategies and assessment techniques. The framework offers detailed guidance—including vignettes and narratives—on what this form of instruction and assessment looks like in the classroom, for both student and teacher.

Just as importantly, this framework also provides guidance on ways to bring the entire mathematics education program into alignment, so that our policies and practice reflect the coordination and coherence implied in “systemic” reform. Thus, although the chapter on content occupies a major portion of the document, there are also chapters detailing why change is needed, best practice strategies, connections among curriculum components, professional development, and resources for teachers to achieve high quality mathematics education for all students at every level of the K-12 system.

The *Minnesota K-12 Mathematics Framework* is a “road map” for implementing the *Minnesota Graduation Standards* in mathematics—a road map for getting to stronger, more relevant mathematics education for every one of our students. It does not dictate exactly how we get to the goal, but offers guidance on helpful options and alternative routes. It also reminds us that effective teaching of mathematics can happen only within a system of learning that is supported by consistent policies, sufficient resources, continuous improvement, and universal responsibility for achieving the vision. Those of us who are stakeholders—parents, community members, legislators, and representatives from business and higher education can use the framework to better understand the direction and support teachers need to achieve the vision in the standards.

Bill Linder-Scholer, Ph.D.
Executive Director, SciMath^{MN}
September, 1997

What is a Framework?

“State curriculum frameworks can provide a common point of reference for state, district, and local educators to coordinate the many components of the instructional system.”

Association for Supervision and Curriculum Development. (1992). *Using curriculum frameworks for systemic reform*. Alexandria, VA: Author.

A framework is a document that represents the best thinking about the knowledge, skills, and processes students should know, understand, and be able to do as a result of their education in a particular discipline. It reflects the policy and educational goals of the state and provides a structure for organizing the components of the instructional system. A framework is a tool that provides guidance for curriculum selection and development, instruction, and assessment at the local level. It is not intended to serve as a curriculum, but rather a guide, emphasizing what students should know and be able to do at various points as they move through the system.

A framework also provides direction in aligning curriculum, instruction, and assessment across the educational system and guidance for connecting all components of the educational system to improve student achievement. It can be used as a catalyst for improving professional development to better support teachers as they create sound learning environments, implement instructional strategies, and select resources that will maximize learning for all students.

The *Minnesota K-12 Mathematics Framework* is designed to be used in concert with the National Council of Teachers of Mathematics’ (NCTM) *Curriculum and Evaluation Standards for School Mathematics* and the *Minnesota Graduation Standards*. It is a parallel document to the *Minnesota K-12 Science Framework* and a companion to *Transforming Teacher Education*, SciMath^{MN}’s framework for pre-service education.

The Minnesota K-12 Mathematics Framework:

- shows connections between the National Council of Teachers of Mathematics’ *Curriculum and Evaluation Standards for School Mathematics* and the *Minnesota Graduation Standards*
- provides information to guide choices about curriculum, instruction, and assessment including how to make connections within mathematics, across disciplines, and with the world of work
- provides descriptions of research-based best practice strategies in mathematics education
- provides direction for professional development
- provides direction to districts, schools, and teachers while allowing them flexibility in designing instructional programs for students
- provides a variety of resources for teachers and other stakeholders, including rationale and suggestions for implementing change in mathematics education

This Framework

Chapter 1—The Case for Change

We Believe...

What is Mathematics?

Why Does Mathematics Education Have to Change?

What Needs to Change?

How Do We Change?

Chapter 2—Best Practice: Research in Teaching & Learning

Part 1: Focusing on the Learner

Brain Research • Cognitive Psychology Research • Making Teaching Decisions Based on How Children Learn • Providing Opportunities for Active Student Engagement • Analyzing Student Learning to Improve Instruction

Part 2: Promoting Effective Classroom Instruction and Assessment

Planning Meaningful Tasks • Using Concrete Materials • Integrating Technology • Assessing Student Performance

Part 3: Promoting Effective Classroom Interactions

Increasing Wait Time • Questioning for Higher Order Thinking • Structuring Collaborative Learning • Incorporating Oral and Written Communication

Part 4: Reaching All Students

Gender • Race, Ethnicity, and Culture • Language • Physical Disabilities • Learning Styles • Detracking • Reaching All Students: A Summary

Chapter 3—Mathematics Curriculum Content Strands

Content Overview

Number Sense

Shape, Space & Measurement

Data Investigation

Randomness & Uncertainty

Patterns, Relationships & Functions

Discrete Mathematics

Chapter 4—Connections

Part 1: Interrelationships within Mathematics

Connections among Representations of a Concept • Connections within or across Mathematical Strands • Integrated Mathematics Curriculum • K-12 Articulation • Structure of Mathematics

Part 2: Connections between Mathematics and Other Disciplines

Thematic Connections • Connections between Mathematics and Science • Connections to Other Disciplines

Part 3: Application-based Connections

Research Base for Applications • Real-life Connections within the Classroom • Real-life Connections to the Workplace

Part 4: Tools for Planning Curriculum Connections

Concept Mapping • Curriculum Planning Wheel • Team Model for Secondary Interdisciplinary Planning

Chapter 5—Professional Development

Principles for Professional Development

Guidelines for Personal Professional Development Planning

Strategies for Professional Learning

Chapter 6—Resources and Support

National Science Foundation (NSF) Curriculum Projects

(Additional resources available on the SciMath^{MN} web site

<http://www.scimathmn.informns.K12.mn.us>)

Chapter 7—Making It Happen: Implementing Standards-based Reform in Mathematics Education

The Change Process

Systemic Reform

Roles of Stakeholders

Summary

Appendices

Acknowledgments

A Sample Scope and Sequence for Shape, Space & Measurement

B What Should I Look for in a Math Classroom?

C SciMath^{MN} Statement of Equity for Mathematics and Science Education

D Summary of 1996 NAEP (National Assessment of Educational Progress) Results for Minnesota

How to Read and Use This Document

While this *Framework* is a wonderful source for teachers and others to practice their technical reading skills, it was never intended to be read from cover to cover. The following are sample questions that might guide you to appropriate sections. You are encouraged to read these pages with a group of your peers or colleagues, as they were written to foster professional conversations among all those concerned with improving students' learning of mathematics.

Question/Concern:

Parent:

"I would like to know what should go on in my child's math class."

Superintendent:

"I would like to be able to explain the changes in mathematics education better to our parents."

Teacher:

"I have read the national and state standards for my students but they don't give me enough detail to know what to teach."

Teacher:

"I hear there are some new curriculum projects that will help us deliver Graduation Standards. Where can I get more information?"

Business Leader:

"We want to help our local schools, but we aren't sure how to do it."

Staff Development Person:

"I want to plan more effective professional development for our mathematics teachers."

Teacher Evaluation Committee Person:

"We are a district committee trying to revise our teacher evaluation system. Are there implications for mathematics teachers that we should be considering?"

Principal:

"How can I help my teachers work together to provide more integrated learning experiences for our students?"

Mathematics Coordinator:

"We are trying to adopt a more coherent K-12 curriculum. How can this document help?"

Counselor:

"How can I get enough information about the changes in mathematics to help students choose appropriate courses?"

What to read:

- The classroom vignettes in [Chapter 3](#)
- "What Should I Look for in a Math Classroom" in the [Appendix](#)
- [Chapter 1](#): The Case for Change
- The Work Vignettes in [Chapter 3](#)
- [Chapter 7](#): Making It Happen - especially "Focus on Parents, Guardians, and Other Caregivers"
- The "Mathematics Alignment" chart in the content overview section of [Chapter 3](#)
- The COMPONENTS section in each content area of [Chapter 3](#)
- Information on the NSF Projects in [Chapter 6](#)
- SAMPLE TASKS in [Chapter 3](#)
- [Chapter 7](#): Making It Happen, especially the section on what business leaders can do. Also check the REFERENCES for more specific sources addressing the issue of business involvement in education.
- [Chapter 2](#): Best Practice - to help you identify needs
- [Chapter 5](#): Professional Development - to help you plan a program to meet those needs
- [Chapter 2](#): Best Practice
- [Chapter 5](#): Professional Development, section on Developing a Personal Professional Development Plan
- "What Should I Look for in a Math Classroom" in the [Appendix](#)
- [Chapter 4](#): Connections
- [Chapter 3](#): Content - especially the FOCUS and COMPONENTS sections
- [Chapter 6](#): Resources and Support
- [Chapter 1](#): The Case for Change
- [Chapter 3](#): Content, especially the REFLECTIONS section in each content area

