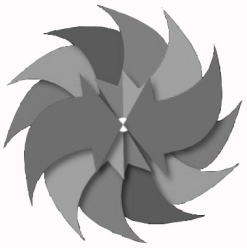
Catalyzing Change in High School Mathematics and SIMMS IM[1] High School Curriculum: Comparing Key Recommendations with Philosophy and Practice

Catalyzing Change in High School Mathematics: Initiating Critical Conversations 	*SIMMS Integrated Mathematics: A Modeling Approach Using Technology* 
KEY RECOMMENDATIONS	**CURRICULUM PHILOSOPHY & PRACTICE**
I. Each and every very student should learn the Essential Concepts in order to expand professional opportunities, understand and critique the world, and experience the joy, wonder, and beauty of mathematics. • Reasoning, proof and the cycle of inquiry and justification. • Mathematical modeling and the modeling cycle. • Technology as a driver of change in student engagement.	Nearly every mathematics concept is introduced and studied within a real-world context to engage students and provide insight into the usefulness of mathematics in a wide range of settings. This approach heightens—and holds—student interest and helps them in subsequent modules (chapters) to recall the mathematics and how it was applied. In every Activity (lesson) students begin their investigation of the mathematical topics in Explorations. The investigation of the mathematics often requires students to collect and analyze data, make conjectures, build a model, or explore possible solutions to a problem. Built-in Discussions allow students to reflect upon the mathematics they encountered in the Exploration. In the Discussions students share their understanding, reasoning, and insights of the mathematics just investigated. They also facilitate an opportunity for students to share different methods used to arrive at the same mathematical conclusions. Within the Assignments, as well as the Discussions, students are expected to explain and justify each of their responses using mathematical arguments, including proof where applicable. The curriculum facilitates modeling, conceptual mathematizing, problem solving, and integrating among human, environmental, physical, and math systems. The appropriate use of technology as a learning tool, not merely a doing tool, is integrated throughout the curriculum. Each student is expected to have access to technology that provides function and data graphing, ease in creating multiple

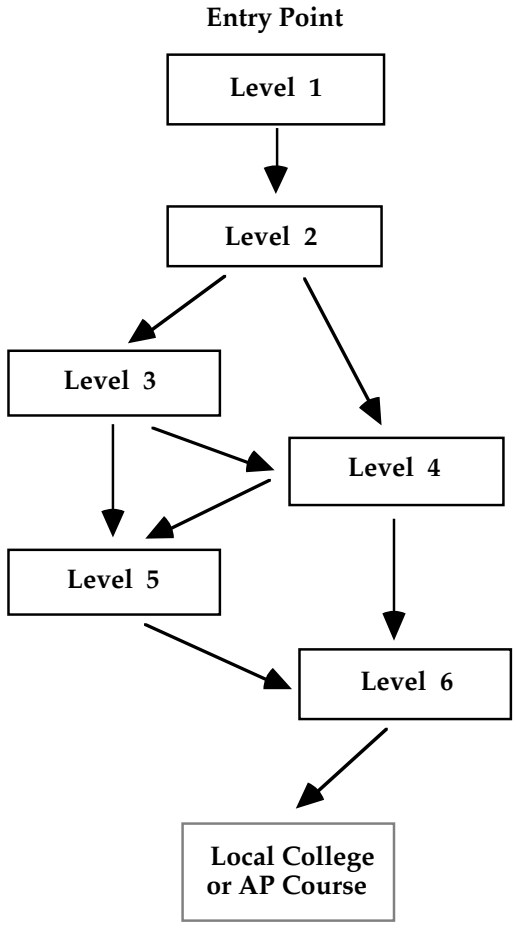
	representations, a spreadsheet, statistics and data analysis capabilities, a dynamic geometry program, and a symbolic manipulator. All of these technological requirements are available on hand-held devices or computers.
II. High school mathematics should discontinue the practice of tracking teachers as well as students into qualitatively different or dead-end pathways.	Core philosophy includes: *All* students can do mathematics; *All* students can learn mathematics; *All* students can make mathematically informed decisions; Mathematics must be accessible to students of *all* physical, mental, and learning abilities or disabilities. Materials designed to facilitate multiple learning styles and delivery modes and to address the needs of students of both genders, all races and those with special disabilities and provides material and instruction to strengthen sensitivity to the value of multiple perspectives and the negative effects of bias and stereotyping.
III. Classroom instruction should be consistent with research-informed and equitable teaching practices. • Establish mathematics to focus learning • Implement tasks that promote reasoning and problem solving. • Use and connect mathematical representations. • Facilitate meaning mathematical discourse. • Pose purposeful questions • Build procedural fluency from conceptual understanding. • Support productive struggle in learning mathematics. • Elicit and use evidence of student thinking.	*SIMMS IM* is a complete mathematics curriculum *for all students* based on the philosophies outlined in NCTM's *Principles and Standards for School Mathematics* (*PSSM*) (2000). The curriculum is designed to replace all grade 9-12 mathematics courses, with the possible exception of advanced placement courses. Facilitating multiple learning styles is a central focus of the curriculum pedagogy. Students have the opportunity to use a wide range of approaches in their learning. At times students work independently, in pairs, or in small collaborative groups. In other instances there are whole-class discussions to share the common knowledge generated through explorations included in the curriculum. There are additional learning opportunities that often involve written reports and/or oral presentations by the students. Appropriate use of technology aids students in gaining a deeper understanding of the mathematics presented through the examination and comparison of various mathematical representations. By solving problems presented within a given context, students become more adept at true problem solving—that is finding a solution

	to a problem when the solution method may not be immediately obvious. Having opportunities to apply the same mathematics in different contexts helps students learn to apply the mathematics across a wide range of situations. In the process of solving the application problems, students gain additional proficiency in the mathematical skills presented in each activity. Students are required students to mathematically justify their answers developing the ability to communicate mathematical reasoning in a variety of ways to a variety of audiences. Included optional Research Projects give students additional opportunities to hone their problem solving and communication skills. They also provide an excellent way for teachers to differentiate the instruction among students of different abilities and aptitudes.
IV. High schools should offer continuous four-year mathematics pathways with all students studying mathematics every year in a common shared pathway focusing on the Essential Concepts, to ensure the highest-quality mathematics education for all students. • Common shared 2-3 year pathway • Integrated Pathway (Pathway B) • Geometry First Pathway (Pathway A)	*SIMMS IM* is an integrated curriculum consisting of six (6) Levels with the intent that all students will have four (4) years of math during grades 9-12. *All* students take the same first two courses (Level 1 and Level 2) during their first two years of high school. The students then have options for the remaining two years (see curriculum pathways at the end of this document) based on the their post-high school plans. In each Level students study algebra, geometry, trigonometry, analysis, statistics, probability, data analysis, and discrete mathematics. The curriculum consists of topics chosen from a wide variety of mathematical fields and integrates those topics to emphasize the connections and unity among those fields; emphasizes the relationships among topics within math as well as between math and other disciplines. All the included math is at an intellectually honest level for *all* students for all 4 years of mathematics.

[1] Full curriculum title is *SIMMS Integrated Mathematics: A Modeling Approach Using Technology*

SIMMS IM Curriculum Possible Pathways

The *Integrated Mathematics* curriculum is grouped into six levels. All students should take at least the first two levels. In the third and fourth years, *Integrated Mathematics* offers a choice of courses to students and their parents, depending on interests and goals. A flow chart of the curriculum appears in Figure 1.



Level 1: a first-year course for ninth graders (or possibly eighth graders)

Level 1 concentrates on the knowledge and understanding that students need to become mathematically literate citizens, while providing the necessary foundation for those who wish to pursue careers involving mathematics and science. Each module in Level 1, as in all levels of the curriculum, presents the relevant mathematics in an applied context. These contexts include the properties of reflected light, population growth, and the manufacture of cardboard containers. Mathematical content includes data collection, presentation, and interpretation; linear, exponential, and step functions; and three-dimensional geometry, including surface area and volume.

Level 2: a second-year course for either ninth or tenth graders

Level 2 continues to build on the mathematics that students need to become mathematically literate citizens. While retaining an emphasis on the presentation and interpretation of data, Level 2 introduces trigonometric ratios and matrices, while also encouraging the development of algebraic skills. Contexts include pyramid construction, small business inventory, genetics, and the allotment of seats in the U.S. House of Representatives.

Levels 3 and 4: options for students in the third year

Both levels build on the mathematics content in Level 2 and provide opportunities for students to expand their mathematical understanding. Most students planning careers in math and science will choose Level 4. While Level 3 also may be suitable for some of these students, it offers a slightly different mixture of context and content.

Contexts in Level 4 include launching a new business, historic rainfall patterns, the pH scale, topology, and scheduling. The mathematical content includes rational, logarithmic, and circular functions, proof, and combinatorics.

In Level 3, contexts include nutrition, surveying, and quality control. Mathematical topics include linear programming, curve-fitting, polynomial functions, and sampling.

Levels 5 and 6: options for students in the fourth year

Level 6 materials continue the presentation of mathematics through applied contexts while embracing a broader mathematical perspective. For example, Level 6 modules explore operations on functions, instantaneous rates of change, complex numbers, and parametric equations.

Level 5 focuses more specifically on applications from business and the social sciences, including hypothesis testing, Markov chains, and game theory.