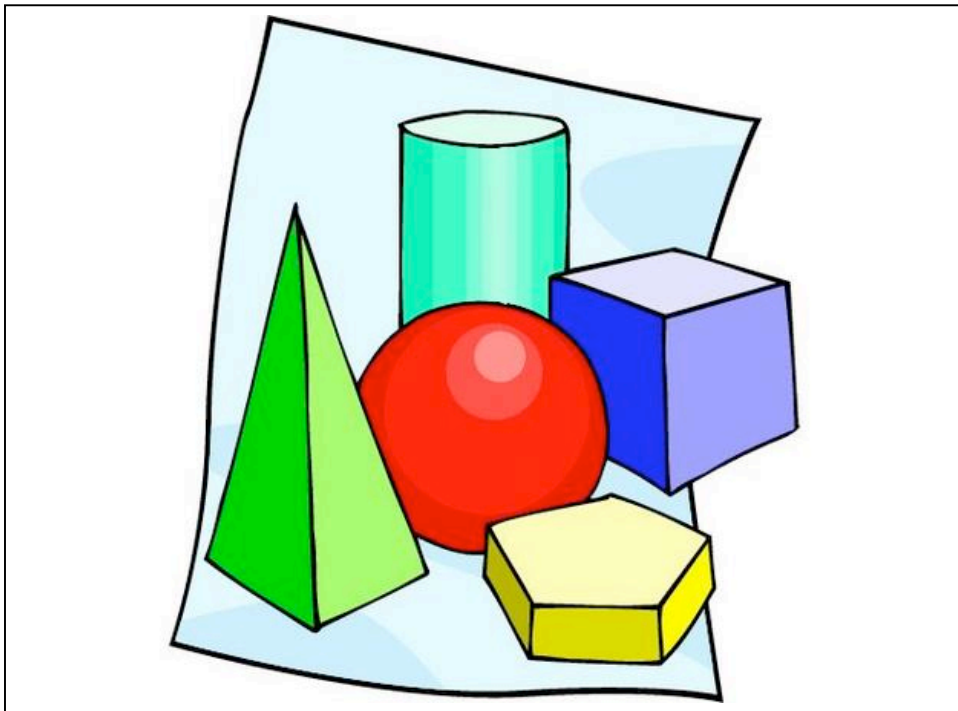


# High School Mathematics

## Program Review Report



April 17, 2007

## Table of Contents

Background.....	2
Teacher profile.....	4
Student Learning.....	5
Curriculum.....	8
Instruction.....	11
Assessment.....	13
Leadership.....	15
Professional Development.....	17
Community/Culture.....	19
Conclusion.....	20

## Background

This report is part of the district's on-going systematic assessment of curriculum. Last year, the first program assessment, that of the elementary mathematics program, was completed. This year's assessments involve those of the middle school and high school mathematics programs. This report about the high school mathematics program was generated from information obtained from existing NHS data, the NPS performance report, teacher surveys and interviews, student surveys, and parent surveys. During the 2006 – 2007 school year, the department is servicing a total of 1559 students: 1462 students in full-year courses, 37 students in half-year courses, and 60 students in the MCAS review course.

All fifteen teachers in the department during the 2005 – 2006 school year completed the **teacher survey**.

The **student survey** was distributed in June. Underclassmen completed the survey during their mathematics class, while surveys for the seniors were mailed to their homes. Two students per class were selected at random to insure that all populations from every course and level were represented. The 120 student responses can be described as follows:

### Year of Graduation

YOG	% Respondents
2006	12
2007	32
2008	28
2009	28

### Math Student Distribution as of October 4, 2006

Course level	Percent
Unleveled	6
Standard	8
Honors	51
Accelerated	35

### Enrollment by Math program

Program	% Respondents
Traditional	77
IMP	13
IMP/Traditional	8
Did not respond	2

Currently, traditional students comprise 93.5% of the enrollment whereas IMP students comprise 6.5% of the enrollment.

### Enrollment by Course levels

Course level	% Respondents
Standard only	12
Standard and Honors	7
Honors only	43
Honors and Accelerated	8
Accelerated only	30

### Student Distribution by Math Grade

Course level	% Respondents
A's	18
A's and B's	28
B's	14
B's and C's	26
C's	7
C's and D's	5
D's	<1
F's	<1

The above descriptions indicate that the student respondents represent a diverse population of students.

The **parent survey** was mailed in two cycles to randomly selected homes. A minimum of 120 responses was desired in order to satisfy statistical parameters. When the response to the first mailing of 500 parent surveys was weak, a second mailing of 100 parent surveys was sent. The total number of parent responses was 110 responses (an 18.3% return rate) that can be described as follows:

Graduation year of student

YOG	% Respondents
2006	21
2007	27
2008	23
2009	27
Did not respond	2

Mathematics program in which the student has been enrolled

Program	% Respondents
Traditional	78
IMP	15
IMP/Traditional	4
Did not respond	3

Course levels in which the student has been enrolled

Course level	% Respondents
Standard only	5
Standard and Honors	1
Honors only	43
Honors and Accelerated	7
Accelerated only	42
Did not respond	3

The parent respondents represent a diverse group. However due to voluntary response bias the parent data respondents are most likely to be those who are truly interested in the high school mathematics program or those with a perspective about the program they wished to communicate.

## Teacher Profile

Currently, within the NHS mathematics department there are 13 teachers teaching five classes each, 1 teacher teaching 4 classes and the department chairperson teaching two classes. As of September 24, 2006 the average teacher load was 105 students with a range from 88 students to 119 students.

### Experience level of teachers:

Years teaching	% Respondents	Years in Needham	% Respondents
10 or more	20	More than 10	13
Between 6 and 10	33	Between 6 and 10	33
Between 0 and 5	47	Between 1 and 5	54

### Level of expertise

- All teachers in the mathematics department have a masters degree.
- All teachers have pursued post-masters degree study.
- 7% of teachers have received a masters degree in mathematics.
- 67% of teachers have received a masters degree in the teaching of mathematics.
- 27% of teachers have received a masters degree in a field related to mathematics.

Needham High School students have the benefit of a professional mathematics staff that is highly -trained in mathematics and the teaching of mathematics. In addition, these teachers are life-long learners who continue to study and improve their practice.

## Student Learning

*To what extent do students meet or exceed benchmark expectations of curriculum essentials in the subject area under investigation?*

A benchmark for graduation is the passing of the MCAS mathematics examination given in grade 10. All Class of 2005 and Class of 2006 students who took the MCAS passed either the spring or fall exam. Below is a chart comparing the percent of students at each MCAS performance level for Needham and for the state.

Test date	% Students at each performance level							
	Advanced		Proficient		Needs Improvement		Warning/Failing	
	NHS	MA	NHS	MA	NHS	MA	NHS	MA
2004	57	29	29	28	11	28	3	15
2005	66	35	24	27	7	24	2	5
2006	75	40	17	27	6	21	2	12

For the May 2006 exam, 92% of the students scored in the advanced or proficient categories. This is a significant improvement from the May 2004, grade 8 scores of this same student population when only 66% of the students scored advanced or proficient.

The following chart has the 2005 MCAS tenth-grade mathematics test data sorted by student status, gender, race/ethnicity, and income. (Note: the 2006 data is not yet available from the Department of Education.)

Student status	Students Included		% Students at each performance level			
	No.	%	A	P	NI	W/F
Regular	294	83	73	23	3	0
Special Education	60	17	37	28	25	10
Limited English proficient	1	0	-	-	-	-
<b>Gender</b>						
Female	167	47	63	25	9	2
Male	186	52	70	23	6	1
<b>Race/ethnicity</b>						
African-American	9	3	-	-	-	-
Asian or Pacific Islander	18	5	61	22	17	0
Hispanic	10	3	40	40	20	0
Native American	0	0				
White	317	89	69	22	7	2
<b>Low income</b>	12	3	25	50	17	8

Since the number of African-American students taking the MCAS mathematics test was less than 10, the number of students at each performance level is not available. However, in January of 2006, a departmental study of student course placement by ethnicity was conducted. The registrar provided a list of those students registered at NHS under the following three ethnic categories: 02, Asian; 03, African American; 99, Hispanic/Latino. The course level (standard, honors, or accelerated) of each student was determined for all years in which the student was enrolled math. A summary of the study results appears below.

Course levels	% Asian	% African American	% Hispanic/Latino
All standard	4	29.5	34
Mixed standard and honors	7	9.2	17
All honors	26	54.5	37
Mixed honors and accelerated	4	4.5	6
All accelerated	59	2.3	6
Total students	70	44	35

The data indicate that our sub-populations are diverse across different course levels. However, we should continue to focus on eliminating the performance gap of African-American and Hispanic/Latino populations.

Although the SAT scores are not a benchmark for the curriculum, they are highly visible within the community and serve as another indicator of how well our students are performing. Below are the average scores for the SAT mathematics reasoning tests taken by NHS students and reported by year of graduation.

Year	2002	2003	2004	2005	2006
NHS avg. score	567	580	583	598	588
MA average	516	522	523	527	524
US average	516	519	518	520	518

When the data are sorted by gender, it is evident that the mean scores for both females and males have been rising although, over the five-year period, the mean female score increased by 29 points whereas the mean male score increased by 35 points. The gap between mean male score and female score has varied between 23 and 53 points during that same period. Although data for years 2003 – 2005 show a decrease in the gap, the data for 2006 does not support the claim. Unfortunately there is no other data that help determine the root cause of the variation.

Class	2002	2003	2004	2005	2006
NHS female av. score	533	569	560	571	562
NHS male av. score	580	593	599	594	615
Difference	53	24	39	23	53

A significant number of NHS students also take the SAT II mathematics test. Below are the average scores for the graduating classes over the last five years.

Class	2002	2003	2004	2005	2006
Math 1C- NHS	602	605	612	604	628
MA average	595	600	602	602	602
US average	588	590	586	586	593
Math 2C-NHS	667	656	701	676	675
MA average	651	657	670	673	670
US average	659	662	669	670	644

The Advanced Placement courses offered by the mathematics department are Calculus BC, Calculus AB, Computer Science, and Statistics. The AP Computer Science course did not run during the school years 2005-2006 and 2006-2007 due to an inadequate enrollment. The results of the tests for the past three years are as follows:

		2004	2005	2006
Calculus BC	n=	24	20	26
	mean	3.679	4.750	4.577
	Range	1 - 5	3 - 5	3 - 5
Calculus AB	n=	54	69	82
	mean	4.000	3.960	4.370
	Range	2 - 5	2 - 5	2 - 5
Statistics	n=	18	38	61
	mean	3.944	3.579	2.885
	Range	2 - 5	1 - 5	1-5
Comp. Sci. AB	n=	5	12	0
	mean	4.200	4.417	
	Range	3 - 5	3 - 5	

This is evidence that the NHS students in AP Computer Science, Calculus BC, Calculus AB, and Statistics successfully complete the college-level curriculum. In fact, in October 2006 the department received a letter from the College Board identifying the Calculus AB and Statistics courses offered at NHS as being among the top courses in the state. The data for AP Statistics shows a significant increase in the number of test takers. Prior to 2006, many students who enrolled in the class chose not to take the examination; in fact, many students select this course in order to have an AP course represented on their transcripts. For the May 2006 exam, most of the students enrolled in the course took the exam. A study is underway to correlate AP Statistics exam scores with course grades, and determine better routes of communication about the student characteristics required to be successful in the course.

### Student Learning Strengths:

- Students perform well on the MCAS grade 10 mathematics exam, that is, well above the state average.
- SAT mathematics reasoning test average scores are steady and above the state and national averages.
- SAT subject matter average scores are above the state and national averages.
- AP Calculus, Statistics, and Computer Science students successfully complete the college-level curriculum.
- Our sub-populations are enrolled in a variety of different course levels.

### Student Learning Recommendations:

- Determine necessary changes in enrollment practices to strengthen the AP Statistics course.
- Continue to monitor the numbers of sub-population students in each course level and their achievement levels to ensure that the program is addressing the needs of all our students.

## Curriculum

*To what extent is an organized, articulated, up to date curriculum in place?*

The mathematics curriculum allows students to pursue their study through two programs, a traditional program and the Interactive Mathematics Program (IMP). The traditional program includes courses in algebra, geometry, pre-calculus, and calculus. The IMP program is a spiraling curriculum in which the students study algebra, geometry, and pre-calculus topics each year over a period of several years.

Current curriculum documents consist of course essentials, pacing guides, and resource materials. The course essentials for each course list the knowledge and skills that students should have upon completion of the course. These documents are available to teachers on-line in the Curriculum Data Base and as hard copy in the mathematics office. The course essentials are currently available for all mathematics courses except the two courses instituted this year--Personal Finance and Advanced Algebra and Trigonometry. The pacing guides are in calendar format listing the course content, the sequence of the topics, the number of classes devoted to each topic. These pacing guides insure that students in every section of the same course receive comparable experiences with the curriculum. The pacing guides are located on-line in the Mathematics Conference on First Class as well as in hard-copy form in the mathematics office. Curriculum resources are posted in the Mathematics Conference page, which allows teachers easy access to the materials as well as a format for sharing materials with other teachers in the department. All teachers felt that the curriculum for each course is well documented and readily available to them.

There are a variety of ways in which a student can complete their mathematics study through the traditional program. The following chart indicates some of these alternatives for each grade level:

9	Algebra 2 Honors □	Algebra 2 Acc □	Algebra 1 S □	Algebra 1 Honors □
10	Geometry Honors □	Geometry Acc □	Geometry S □	Geometry Honors □
11	Precalculus: H or S □	Precalculus BC, AB or H □	Algebra 2 S □	Algebra 2 Honors □
12	Calculus H	AP Calculus: BC or AB; Calculus H	Advanced Algebra & Trig; Precalculus S	Advanced Algebra & Trig; Precalculus: H or S

In addition to the above courses, students may also enroll in a number of electives including Accounting, Personal Finance, one of two levels of Statistics, two courses in computer science, and the MCAS review program.

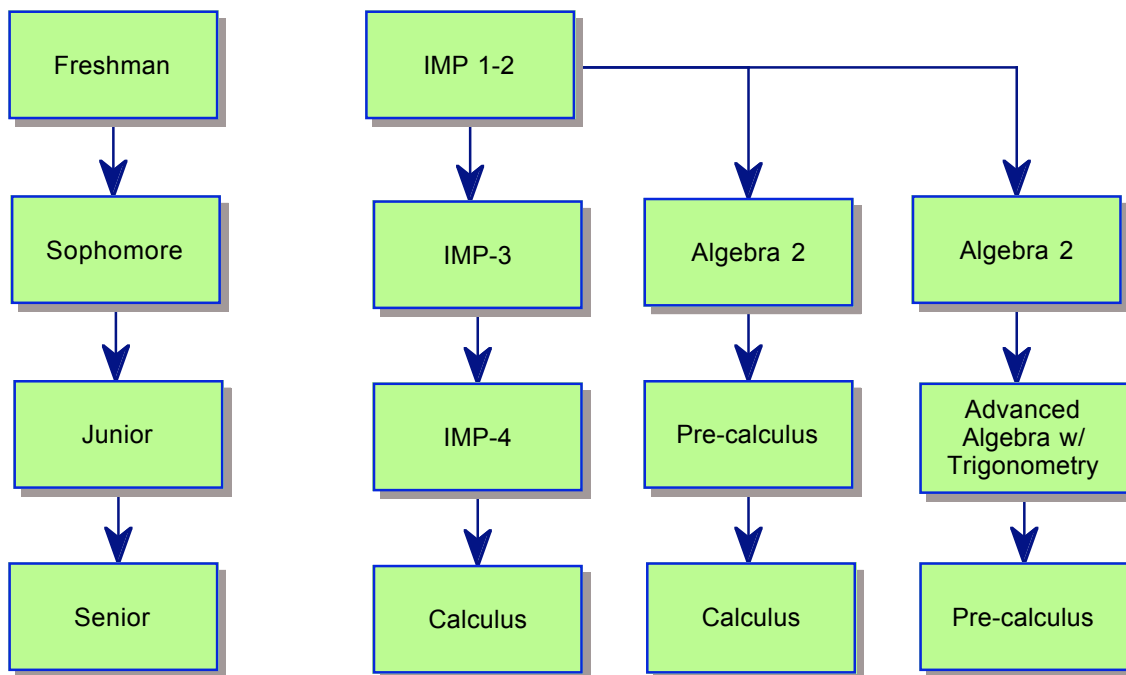
The IMP program has received considerable attention in the parent community. Some members of the community have questioned the value of the program, yet the parent survey indicated that 67% of the respondents thought that both the IMP and traditional programs should be offered to students. Only 16% of parent respondents thought that only the traditional program should be offered.

In an effort to clarify the basis and effectiveness of the IMP program, a study was shared with the school committee in the spring of 2006. The report included the following comparison of the SAT results of traditional and IMP students:

	2001-2002	2002-2003	2003-2004	2004-2005	2005-2006
<b>Mean IMP SAT Score</b>	583	591	585	592	596
<b>Mean Non-IMP SAT Score</b>	567	591	599	596	597
<b>Mean Non-IMP Honors SAT Score</b>	N/A	N/A	588	588	587
<b>National Mean SAT Score</b>	516	519	518	520	N/A
<b>State Mean SAT Score</b>	516	522	523	527	N/A

Note that “Mean non-IMP SAT Score” includes scores of students from accelerated, honors, and standard level traditional courses. These data indicate that on average the students in the honors level IMP program score as well as the honors level students in the traditional program on the mathematics reasoning SAT.

The IMP students are enrolled in the sequence IMP 2, IMP 3, and IMP 4. Adjustments to the curriculum, made in 2006, have made it feasible for students to move to the traditional program. Components of the IMP 1 and IMP 2 curricula were merged into one course to reduce redundancies and to reflect the fact that now all Pollard students are enrolled in an Algebra course. The following chart indicates the current alternatives for those not wishing to complete their studies in the IMP program alone:



This change to the initial course in the IMP sequence also addresses parent concerns that it was too difficult to move into the traditional program once enrolled in IMP.

Some students come to NHS with gaps in their mathematics knowledge and skills. We identify those students based upon their grade 8 mathematics MCAS score as well as input from grade 9 teachers. The identified students, usually numbering between 40 and 60, are enrolled in our highly successful, 10-week MCAS review course, a small group tutorial program. Each year we collect data to assess the value of the program by comparing the individual student's grade 8 and grade 10 mathematics scores. Below are data for students who participated in the MCAS review classes in the springs of 2005 and 2006. A change in level is defined as going from failing to needs improvement or needs improvement to proficient; some students change up to two levels after completing the course.

Year	Average change in raw score	Average % increase in raw score	Average change in level	Number of participants
2005	+11.24 pts	47	1.11	53
2006	+16 pts	77	1.54	39

### **Curriculum Strengths:**

- The curriculum is well articulated in the course essentials, pacing guides, and resource materials that are used regularly by teachers.
- Courses are available for students of all ability levels.
- The IMP program has been redesigned in response to student needs as well as teacher and parent concerns.
- A Personal Finance course has been added to develop students' financial literacy.
- The Advanced Algebra and Trigonometry course has been added to serve students who should further strengthen their algebra skills before taking Precalculus.
- The Accounting course now incorporates computerized practices.

### **Curriculum Recommendations:**

- Update the CDB with the essentials for Personal Finance, and Advanced Algebra and Trigonometry.
- As part of the high school standards-based grading initiative, develop documents that align course essentials to standards.
- Develop methods for better communication with parents about how students are recommended for various courses and levels.
- Make the IMP comparison data more readily available to parents and students to increase awareness of the program's viability.

## Instruction

*To what extent are research-based, best instructional practices being implemented?*

Best instructional practices include curriculum-aligned instruction, data driven decision-making, student-centered and self-directed learning, student support systems, and differentiated instruction. Results of common course benchmark exams and advanced placement exams indicate that instruction is aligned with curriculum. Most math teachers felt that curriculum was well documented and available with the essentials and pacing guides regularly accessed and used by the teachers in the department. Since math is a cumulative subject, it is important that students are adequately prepared for subsequent courses. Seventy-seven percent of parents felt their child's previous experience adequately prepared them for their current class (the numbers were slightly higher for 11<sup>th</sup> and 12<sup>th</sup> grade compared with 9<sup>th</sup> and 10<sup>th</sup> grade.)

## Data Driven Decision-making

The department is increasing its use of data driven decision-making. Current practices include:

- Tenth grade students who had warning/failing scores or needs improvement scores of 230 or below on the 8<sup>th</sup> grade math MCAS are enrolled in the MCAS review program.
- Students new to Needham and students considering a course change are given a test to place them in their appropriate course.
- The department conducts item analyses of the common final exams and uses these analyses to inform instruction.
- The data from the September testing of ninth, tenth, and eleventh grade students in algebra-based courses are used to assess placement and inform instruction.
- All teachers reported they used both formative and summative assessments to inform instruction and incorporate students' prior understanding when planning curriculum and instruction.

## Classroom Instruction Practices

One of the greatest strengths of the department is the active engagement in learning that happens in the mathematics classrooms on a daily basis.

Practice	Responses
Real-world applications	Teachers, parents and students agree that real-world applications are incorporated into the curriculum.
Discovery-based learning	Teachers and students report discovery-based learning happens at least monthly. Few parents (30%) reported awareness of discovery-based learning.
Projects	Teachers, parents, and students all agree that projects are assigned.
Cooperative learning	Teachers, and students report the use of cooperative learning on a weekly basis. Many parents (54%) are aware that students engage in cooperative learning.
Student participation	All teachers report that students lead discussions and make presentations to the class.
Manipulatives	Most teachers (80%) report that manipulatives are used in problem solving.
Homework	Teachers assign homework each night. Most students (89%) consider the amount of math homework reasonable.
Use of technology	Most students report that graphing calculators or computer software are used in their classroom at least biweekly.
Writing about math	Students write about math at least biweekly.
Reflection on learning	Students are not regularly required to reflect on their own learning

It is clear from these reports that teachers actively engage students in their classes. The use of a variety of classroom instruction practices increases the student's interest in mathematics and, according to parents, inspires a positive disposition toward learning.

### Student Support and Assistance

Teachers in the high school math department can regularly be seen helping students in their classrooms both before and after school. They also work closely with teachers in the special education department to ensure support for all students. Students reported that not only were the teachers regularly available for assistance but that many of them also availed themselves of this opportunity. Below are the results of their responses:

	Daily	Weekly	Biweekly	Monthly	Rarely	Never
Teacher availability	66%	33%	<1%	<1%	0	0
Students seeking help	2%	12%	20%	23%	42%	1%

Both students (83%) and parents (74%) felt that teachers accommodate individual student needs. Additionally, all teachers reported they were prepared to encourage equitable participation of males/females, different racial backgrounds, different learning abilities, and different learning styles.

The teachers in the NHS mathematics department use varied instructional strategies and regularly try new strategies in their classrooms. A section of the student survey focused on the frequency of use of different instructional strategies in the classroom. About half the students reported that the following strategies were used at least bi-weekly: teacher lecturing, student presentations, homework, cooperative learning, discovery-based learning, writing about mathematics, taking notes, making mathematical models, using graphing calculators, and practically applying math to everyday life. The other three categories – writing reflections, using computer software, and doing a project- were all reported by a majority of students as happening at least some of the time. Interestingly teachers and parents reported similar frequencies of use of these strategies whereas students reported them as happening with less frequency.

### Instruction Strengths:

- Students are actively engaged in learning.
- The department practices data-driven decision-making.
- Student support is available from teachers before and after school.
- Students take advantage of opportunities of additional assistance.
- Teachers utilize a variety of instructional strategies.
- Self-directed learning is promoted within the department.
- Teachers accommodate the individual needs of students.

### Instruction Recommendations:

- Increase the use of reflection as a learning tool.
- Increase the classroom use of technology to support student learning.
- Develop systems that allow teachers access to individual student data such as MCAS scores, SAT scores, placement test scores, and prior mathematics course grades in order to improve correct course placement.

## Assessment

*To what extent are assessments that reflect student learning goals in place, being implemented, and used to inform instruction?*

With a standards-based approach to instruction, teachers insure that students are aware of the course essentials and that they communicate the goals of each lesson to their students. Both parents and students reported that they are informed of the learning expectations for each course. In addition, most students said that they know the goals for a given lesson and nearly all feel that they have a clear understanding of the basis for their grade.

This year two mathematics teachers are using standards-based grading methods in at least one of their classes. In addition, teachers in the department are committed to adding one new practice in support of standards-based reporting. That practice may include but is not limited to scoring with a holistic rubric, indicating for each test question the standard being assessed, or developing a tracking system to allow students to reflect upon and analyze their ability to solve problems.

Students and parents were asked about the variety of ways that a student could demonstrate their learning. For the most part (85%), students reported that they know if they are learning because of the number of assessments are provided and because their teacher gives them sufficient feedback on their progress. These assessments may be multiple-choice but are typically open response questions requiring written explanations and detailed work. Both parents and students report that students also demonstrate knowledge through classroom presentations, cooperative-learning groups, some writing about mathematics, and about thirty minutes of daily homework. Teachers and students agree that students know what good work looks like. According to the survey, parents are confident with the assessment practices leading to a final grade. Although 85% of parent respondents report that they consider their student's grade to accurately reflect the student's performance, only 26% consider themselves informed as to the method of calculation of the grade. On the other hand, teachers report that their classroom expectations, Parents' Night presentations, and teacher pages on the NPS website include this grading information. This discrepancy indicates that more effective means of communicating assessment practices and grading policies should be developed.

Teachers were also asked about their assessment practices. All teachers reported using both formative and summative assessments to inform instruction. Teacher responses about the variety of assessment practices are similar to those of parents and students. All also agreed about the length of home assignments (thirty-minutes). While most teachers use rubrics to assess student work, only 27% report using the same rubric as their colleagues who are teaching the same course. In the spring of 2006, the mathematics department instituted common course final exams for all students. This means that all students in a given course and level were tested with an examination created by the group of teachers teaching the course. The exam questions were representative of the course essentials. This fall, analysis of the results of the exams was used in order to inform instructional practices in each course as well as to improve the quality of the exam.

In the fall of 2006, the practice of pre-testing all students enrolled in algebra and pre-calculus courses was begun. Previously, only the students enrolled in Algebra 2 Accelerated were tested. The data obtained from these assessments is used to inform instruction and affirm student placement. Teachers now know the strengths and weaknesses of their students by topic and thus are better able to focus on individual student needs. In addition, the accumulated data give a predictive measure regarding the likelihood of the student success in a particular course and level. Thus the parent, counselor, and teacher have data to discuss the current student placement and make adjustments as necessary.

Last year, the district provided teacher training regarding the value and methodology of Looking at Student Work to inform instruction. Presentations and discussions took place in both school-wide and department settings. About half of the high school mathematics teachers report that they have assumed the practice of looking at student work with colleagues. Minimal availability of common planning time, however, limits the ability of teachers to regularly implement this practice.

**Assessment Strengths:**

- Common course final examinations are given throughout the department.
- Pre-testing of students of students in algebra and pre-calculus classes to determine student strengths prior to instruction and to affirm placement decisions..
- A variety of assessment tools are used by teachers to provide multiple opportunities for students to demonstrate their learning.
- Both formative and summative assessments are used by teachers to inform instruction.

**Assessment Recommendations:**

- Provide additional common time to foster Looking at Student Work and sustain collegial learning practices.
- Create more effective venues to communicate with parents about assessment and grading practices.

## Leadership

*To what extent is there leadership in place that ensures skillful management of the program, operations, and resources that promote an effective learning environment?*

After a review of students' historical grades, MCAS scores, course placements, and course essentials, the Department Chairperson supported several changes to the curriculum. These include the restructuring of the IMP program, the updating of the Accounting course to include the use of the software application Quickbooks, and the addition of two new courses, Personal Finance, and Advanced Algebra and Trigonometry. In 2005, an Algebra 1 honors course was added to the curriculum. In the parent survey, parents applauded the addition of this course as a response to student needs. Parent respondents noted their appreciation for the effort to restructure the mathematics program and increase communication.

It is important that the department provides services to all students. To ensure this, a study was completed last year to review the mathematics placement of students by ethnicity. This data is being used to develop a support program to enable students to stretch and grow their mathematical abilities.

Each year, there are a limited number of students who wish to enroll in the AP Computer Science course. This year the course could not be offered due to the limited enrollment. To meet this need a course has been developed in partnership with Olin College of Engineering. Six NHS students attended Olin's Software Design course during the first semester. During the second semester these students will complete the AP curriculum through small group study. Programs such as this allow us to stretch our resources and address student needs.

Department meetings are spent discussing educational methods and practices. Last year using the NCTM publication "Mathematics Assessment: A Handbook, Grades 9–12" as a guide, the department meeting discussions focused on assessment practices. This year's meetings are focusing on articulating the vertical and horizontal integration of course essentials. In addition, teachers will share unique practices at the meetings. When queried, 87% of teachers found the department meetings useful and productive.

Parents who have had contact with the Department Chairperson considered her to be open to comments, concerns, and suggestions. Seventy percent of the parent respondents have had no contact with the Chairperson.

Teacher collaboration has been enhanced by the development of a math conference page on First Class. Each course has a folder where teachers can drop copies of materials they'd like to share with others. These materials include the course essentials, review games, unit overviews, worksheets, tests, quizzes, and rubrics.

Last year, in conjunction with the METCO program, the math department offered an after-school tutoring program for students. Once a week, two teachers work with 6–8 students providing additional instruction and confidence in mathematics.

During the past three years, the 8<sup>th</sup> grade mathematics teachers at Pollard have met with the high school mathematics teachers to better understand and articulate the curriculum in both schools. In addition, Pollard teachers share information about the student selection process and the high school has shared teaching materials as well as the MCAS curriculum. The high school Department Chairperson and the Pollard Grade 8 Mathematics Head Teacher collaborate on a regular basis.

**Leadership Strengths:**

- Student needs are being met in a variety of ways including the MCAS review course, the Olin College program, and the METCO tutoring program.
- Curriculum is being examined and revised continually.
- Teachers find department meetings productive.
- Collaboration among teachers is enhanced through the math conference page on First Class.

**Leadership Recommendations:**

- Develop a support program based on the information from the study of students by ethnicity.
- Continue to improve parent communication regarding the mathematics curriculum choices and characteristics of students at various levels.
- Add final exams and placement test data to the math conference site.

## Professional Development

*To what extent is there a focus on improving teacher skills and capacity to implement the articulated curriculum?*

As noted in the teacher profile section, all teachers in the mathematics department have earned a masters degree and undertaken post-masters course work. This level of expertise is recognized in the parent survey, where a significant number of parents noted that one of the strongest features of the NHS Mathematics Department is the mathematics background of the teachers. In the survey, parents expressed varying views of teachers' knowledge of technology. Given the high level of math teachers' computer skills, it may be that parents were referring to a lack of use of computers in the classroom during class time. That has already changed with the new facility and the teacher and class access to technology. Now with each classroom having a projector which links to their classroom computer, the mathematics teachers have adopted and regularly use the *Smartboard* in their classrooms and are enjoying their newfound ability to incorporate computer-based technology into daily lessons.

To implement the curriculum and prepare effective lessons teachers must have a significant level of mathematical understanding and pedagogical skills. A majority of teachers ( $\geq 80\%$ ) indicated they felt confident in their ability to provide connections between mathematics topics, for example, algebra and geometry, incorporate calculators and/or computers into lessons, develop students' conceptual understanding of mathematics, teach an IMP course, develop lessons with a problem-solving focus, manage a class of students who are using investigative strategies, and present lessons with a student-centered and self-directed approach. However, they were less confident in their ability to incorporate students' prior understanding when planning curriculum and instruction, develop lessons that provide opportunities for students to actively construct their own mathematical knowledge, have students pose their own questions/problems, and connect math to real-life contexts and careers. While it is clear that most teachers have significant content knowledge and pedagogical skills, more attention needs to focus on increasing their skills in these areas.

NHS mathematics teachers are required to attend at least one course of IMP training. The pedagogy introduced in this course not only prepares them to teach the IMP courses but also provides them with the pedagogical skills that are associated with best practices in mathematics instruction. Through this experience teachers are prepared to lead student-centered classrooms and provide a variety of assessment practices. Teachers are also encouraged to complete the "Instruction for All" or the "Differentiated Instruction" course offered through the NPS Staff Development Program. These courses give the teachers the means by which to reach all students in their classrooms.

Continuous professional development is a key aspect for the development of skillful teachers. In the mathematics department, most teachers feel that the availability of professional development is not a problem that limits students' learning. This is evidenced by the fact that 67% of the teachers have taken more than 35 hours of professional development in mathematics or mathematics education over the last three years. When broken down into categories of professional development, the results were:

Professional Development in Prior Three Years	% Teachers
Completed a formal college/university course in math education	73
Observed other teachers teaching mathematics	67
Attended a workshop on mathematics	53
Served as a formal mentor and/or peer coach in mathematics teaching	47
Participated in distance learning or a telecommunications collaboration	33
Attended teacher study groups about mathematics teaching issues	27
Completed a formal college/university mathematics course	20
Attended a national or state mathematics teacher association meeting	7

Teachers in the mathematics department consider the professional development offerings provided to them as beneficial in supporting productive change and continuous improvement. As a result of their participation in professional development offerings, most teachers feel prepared to encourage equitable participation of males and females, encourage equitable participation of students of different racial backgrounds, encourage equitable participation of different learning abilities, encourage equitable participation of different learning styles, and use the computers for student learning in the classroom. Survey responses indicate that additional attention needs to be paid to using technology as a resource for planning lessons and assessments.

**Professional Development Strengths:**

- Teachers have the content knowledge and significant pedagogical skills to implement the curriculum.
- Teachers take advantage of the professional development programs offered by NPS.
- Teachers are trained to provide student-centered and self-directed learning.
- Currently, 80% of the teachers have taken the EMI or similar multi-cultural education course, thus assuring fair and equitable practices.
- Department meetings provide a range of professional development opportunities.

**Professional Development Recommendations:**

- Provide professional development opportunities that link math to real-life contexts and careers and that broaden the range of teachers' repertoire of pedagogical skills.

## **Community/Culture**

*To what extent do conditions promote collaborative networks of support for student learning? To what extent do conditions promote teacher community and professional working relationships?*

Looking at student work (LASW) is a technique with which teachers look collaboratively at students' work to analyze students' understanding of particular concepts and to strategize how to best address any misconceptions that occur. There have been several early release days and department meetings focused on looking at student work. In small groups, teachers analyzed tests or homework of individual students using a protocol designed for this purpose. Teachers say that they often discuss issues around grading policies, rubrics, etc., with their colleagues, but have fewer discussions about student work. While 47% of teachers said that they are engaged in looking at student work with colleagues, they felt that the frequency of looking at student work collaboratively should be increased.

### **Consistent Practices**

Common standards and policies are necessary to assure consistency and fairness. All teachers use common end-of-year assessments to measure student learning. All teachers feel that leadership promotes and supports standards-based instructional practice and provides some time for teachers to collaborate on issues around common standards. Teachers that are teaching the same course often collaborate to create common standards, grading policies, and rubrics. Although some department meeting discussions have focused on the possibility of using common unit tests and grading rubrics, no departmental policy has been defined as yet.

### **Common Planning Time**

Common planning time is essential for the development of consistent practices and strong programs. Most (87%) teachers report that leadership provides some opportunities for teachers to meet with colleagues to discuss curriculum and instruction matters. Teachers say that they informally discuss issues around teaching and learning with their colleagues on a regular basis. Department meeting time is also often used for this purpose and teachers feel that department meeting time is used productively.

### **Horizontal/Vertical Articulation**

In order to have a well-articulated K-12 curriculum, communication between teachers at each level is important. During the last three years, contact between high school and 8<sup>th</sup> grade teachers has increased significantly. Communications have included common meeting times to review and modify curriculum, developing better understanding of the student profile for success, and the sharing of data and course recommendations for individual students. Additionally, input from the Pollard teachers is requested when concerns arise about 9<sup>th</sup> grade students.

### **Community/Culture Strengths:**

- Teachers regularly have discussions about teaching and learning.
- Teachers collaborate on the preparation of common course final examinations.
- Pollard eighth-grade teachers and high school teacher share curriculum and student insights.
- The High School Department Chairperson and the Eighth-grade Math Head Teacher communicate regularly.

### **Community/Culture Recommendations:**

- Provide additional time so that "Looking at Student Work" can continue.
- Continue focused discussions regarding common assessment practices with an eye to developing common unit tests and grading rubrics.

## Conclusion

This review has highlighted many of the strong aspects of the High School mathematics program. The teachers work diligently with their students; the students are learning; and the parents are informed and interested in their child's achievements. Benchmark scores indicate that our students are competitive regionally and nationally. The curriculum is reviewed continually to assure that all students are served. Teachers participate in professional development so that instruction will be excellent. Assessment practices give students a variety of ways to demonstrate their learning. With the high school mathematics program review complete, the next task is to implement changes based on the included recommendations. These changes will strengthen this already strong department.