MATHEMATICS AND SCIENCE SPECIALTY HIGH SCHOOLS SERVING A DIVERSE STUDENT BODY: WHAT'S DIFFERENT?

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Introduction

What do science and mathematics specialty high schools[1] do to recruit, enroll, and support a broad-based student body? What special programs do they offer? What are the distinguishing characteristics of their curricula that are designed for diverse student abilities and interests?

To answer these questions, the Learning Research and Development Center (LRDC) at the University of Pittsburgh, commissioned a study of a limited number of such schools as part of the SCALE Project (System-Wide Change for All Learners and Educators). Its purpose was to gather information to help comprehensive high schools strengthen their mathematics and science curricula, especially high schools serving students who lack access to specialty science and mathematics schools.

The study had two parts. In the first part the researcher identified schools that appeared to have a broad-based student body. The schools were selected from the National Consortium for Specialized Secondary Schools of Mathematics, Science and Technology (NCSSSMST),[2] a membership organization of more than 80 secondary schools specializing in science, mathematics, technology, or engineering.

Following a review of web sites, document retrieval, and telephone inquiries, 14 institutions specializing in mathematics and science were chosen for a preliminary report aimed at identifying appropriate schools for further study.

LRDC and SCALE staff and the researcher agreed that she would solicit the participation of all 14 schools. Each school was required to complete a profile (*see Appendix B*), participate in an interview, and then review the report for accuracy. For their participation each school received a $100 gift certificate. Eight of the 14 chose to be involved in the study. Of the six declining, one did not respond to the initial request; one was not interested; three indicated an interest but did not follow through; and, upon closer examination, one did not meet the selection criteria.

This report provides an overview of the participating schools, looks at strategies that the schools use for recruiting and supporting a diverse student body, examines the schools' curricula, and reports the results of interviews with key school officials. It concludes with recommendations for administrators of comprehensive high schools who want to strengthen their mathematics and science offerings or for educators who are considering starting a specialty school (private or public) for a diverse student body.

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1 Mathematics and science specialty high schools are those institutions established specifically to serve a student body with talent and interest in mathematics and science.

2 The NCSSSMST provides assistance to member schools on increasing diversity. It has a publication entitled "Increasing Underrepresented Populations in NCSSSMST Schools" and sponsors conferences on the topic.

Overview of the Schools

Table 1 is a listing of the schools participating in the study and their location.

Table 1: Mathematics and Science Specialty High Schools Participating in the Study

School	Location
AMES Charter High School (AMES)	Salt Lake City, Utah
Center for Advanced Studies in Science, Math, and Technology at Wheeler High School (Center for Advanced Studies at Wheeler)	Marietta, Georgia
The Charter School of Wilmington	Wilmington, Delaware
Granada Hills Charter High School/CSUN Math, Science and Technology Magnet (Granada Hills)	Granada Hills, California
Illinois Mathematics and Science Academy (IMSA)	Aurora, Illinois
Manhasset High School	Manhasset, New York
Mathematics and Science Academy at Ocean Lakes High School (Ocean Lakes)	Virginia Beach, Virginia
North Carolina School of Science and Mathematics (NCSSM)	Durham, North Carolina

The schools are geographically diverse, with two each in the East, Midwest and West regions of the United States, and three in the South. Three are charter schools (AMES Charter High School, Charter School of Wilmington, and Granada Hills Charter High School), four are magnet schools (Center for Advanced Studies in Science, Math, and Technology at Wheeler High School; Illinois Mathematics and Science Academy; Mathematics and Science Academy at Ocean Lakes High School; and the North Carolina School of Science and Mathematics), and one (Manhasset High School) is a community high school. Four of the schools function as a school-within-a-school (AMES Charter High School; the Center for Advanced Studies in Science, Math, and Technology at Wheeler High School; Granada Hills Charter High School; and the Mathematics and Science Academy at Ocean Lakes High School.)

All are “day” schools with the exception of the Illinois Mathematics and Science Academy and the North Carolina School of Science and Mathematics, which are residential institutions drawing students from across their respective states. All of the “day” schools offer four years of schooling; North Carolina School of Science and Mathematics provides two years; and the Illinois Mathematics and Science Academy, three years. Enrollments range from a low of 400 to a high of 934. Six have a standard

admissions procedure (grades, test scores, recommendations, etc.), while two (AMES Charter High School and Granada Charter High School) have an open enrollment policy whereby students are selected by a lottery. These data are summarized in Table 2 and may also be found in the schools' profiles in Appendix B.

Table 2: Characteristics of Mathematic and Science Specialty High Schools

	Type of School	Day or Residential	No. of Years of Schooling	No. of Students Enrolled	Admissions Criteria
AMES	Charter (school-within-a-school. Also an Early College High School)	Day	4	400	Open enrollment
Wheeler	Magnet (school-within-a-school)	Day	4	400	Standard
Wilmington	Charter	Day	4	934	Standard
Granada Hills	Charter (school-within-a-school)	Day	4	443	Open enrollment
IMSA	State Magnet	Residential	3	650	Standard
Manhasset	Community-based High School	Day	4	781 (entire school)	Standard
Ocean Lakes	Magnet (school-within-a-school)	Day	4	500	Standard
NCSSM	State Magnet	Residential	2	620	Standard

Strategies for Recruiting a Diverse Student Body

This section discusses two broad-based strategies that schools reported using to recruit a diverse student body: open enrollment and services and programs targeted toward under represented students.

Open Enrollment

Two of the schools in this study have a policy of open enrollment. Essentially any student in a given attendance area (and sometimes beyond) can apply for admission to the mathematics and science specialty school. The assumption is that only students who are very interested in science and mathematics will apply. However, application alone does not guarantee admission. School capacity limits and non-academic admissions criteria can prevent admission for some applicants.

For example, Granada Hills Charter High School assigns points based on factors such as the geographic location of the students' home, their race or ethnicity, and whether they have or have had siblings attending the school. This school also operates a program especially for deaf and hearing-impaired students with a special interest in mathematics, science, and/or technology so these students have a competitive admissions edge over hearing and speaking students. Students with the highest number of points are admitted

through a lottery, with about half of those with a sufficient number of points accepted each year. Those qualifying but not accepted because of space limitations are placed on a waiting list. The school maintains a student ratio of 60 percent ethnic and 40 percent Caucasian.

AMES Charter High School recruits from a self-selection lottery of eighth grade students. The school's demographics reflect the overall demographics of the 14 high schools from which students are recruited. The school has no entrance examination.

Although all of the schools in this study promote student diversity, the two with open enrollment policies are most explicit in stating their diversity goals. According to the school literature, AMES "is not about attracting students with the highest GPAs and best SAT scores. AMES is a public school with open enrollment to all students. After acceptance, students' interests and abilities will be assessed in conjunction with staff and parents to determine course readiness and placement." Granada Hills states that it "seeks to promote achievement in mathematics and science among under-represented minority students, young women, and deaf and hard-of-hearing students."

All other schools except Manhasset have a more standard admissions policy. (Manhasset is a public high school serving a small community.) These policies require some combination of the following: students' grade transcripts, standardized test scores, admissions test scores, teacher and counselor recommendations, interest and aptitude in science and mathematics, level of communication skills, non-academic recommendations, and leadership and co-curricular activities. These schools require several of the above; none relies exclusively on, for example, standardized test scores or admissions test scores. Also, these schools may consider non-academic factors such as attendance of siblings, where the student lives, and whether the student is the child of an employee. The school may also use a lottery when qualified applicants exceed the number of slots available.

Services and Programs

Each of the two residential institutions (Illinois Mathematics and Science Academy and the North Carolina School of Science and Mathematics) has a staff person dedicated to minority recruiting and retention. The North Carolina person, who is bilingual, visits churches, community organizations, and social clubs across the state as part of the school's recruiting strategy. Both institutions acknowledge the challenges involved in recruiting students, especially minority students, whose parents may be reluctant to allow them to leave home to attend a residential institution.

IMSA sponsors two programs promoting the interest of under represented students in its school:

Summer Enrichment for Academics in Mathematics and Science (SEAMS) -- SEAMS serves students in the summer after their eighth grade year. This two week, residence experience aims to improve students' mathematics, science, and English skills. Group inquiry and problem solving are a primary academic focus, while the residence hall

experience develops interpersonal skills. SEAMS primary goals are: 1) to provide enriching academic experiences that create academic growth and stimulate interest in math and science; and 2) to create an experience that simulates, to some extent, the experience of an enrolled IMSA student.

The Early Involvement Program (EIP) -- This program typically serves ninth graders. It helps underrepresented and economically disadvantaged students improve their mathematics, science, and English skills. In addition, EIP supports the participants' preparation for application to IMSA. The EIP is held on 7-12 consecutive Saturdays during the fall and early spring. The program includes discovery-based and collaborative research as well as preparation for the Scholastic Assessment Test (SAT). Students develop research, decision-making, and self-motivation skills while studying mathematics, wellness, science, and English literature.

Strategies for Supporting a Diverse Student Body

All schools offer several special services and programs for all students. This section will first discuss one example of a special service and/or program — tutoring — that cuts across all of the schools in the study. Next, programs and services at two schools — AMES Charter High School, an open enrollment school; and the Illinois Mathematics and Science Academy, a residential institution with stringent admissions criteria — will be presented as examples of schools providing a broad range of programs and services. Finally, a few of the special services and programs at some of the other schools will be highlighted briefly.

Tutoring

All schools offer tutoring in various forms. For example, at AMES Charter High School teacher and cross age tutoring is part of a voluntary Saturday school for mathematics. This program is held in the students' neighborhoods instead of at the school. AMES also offers small group tutoring for selected students. Co-teaching is provided in elementary algebra classes, and an after-school writing center provides assistance for students in various subject areas. The Charter School of Wilmington provides student assistance every Wednesday with Peer Leaders tutoring all subjects. If Peer Tutoring is insufficient, the school hires a private company (in this case, Back to Basics) for further help. Ocean Lakes offers three types of tutoring: paid tutors who can work with any student, teachers who tutor their own students, and "study blocks" that have teachers assigned to help students who are having difficulty.

Granada Hills contracts with Kaplan Learning Center to conduct a Saturday school with transportation provided. The Center for Advanced Studies at Wheeler participates in a program called Learning Links that serves the entire school. This program has both peer and teacher tutors. Designed primarily for students at risk, many of the tutors are magnet students. Also, several of the schools conduct summer programs. For example, the Center for Advanced Studies at Wheeler has incoming students who are not well grounded in Algebra I take the course on-line (with some face-to-face meetings) during the summer. This enables students to enroll who are not advanced in math but who otherwise meet the

program requirements. This levels the playing field for students with limited educational opportunities.

AMES Charter High School

AMES has a wide variety of student services. For example, there are two guidance counselors and a full-time para-educator for special education students. A federal program consultant coordinates tutoring, special education, and attendance concerns. In addition, each teacher serves as a homeroom advisor. These homeroom advisors meet regularly with a group of about 20 students and offer mentoring and other supportive activities to students in individual and small group settings. There is a registered nurse as well as an internship coordinator who organizes a wide variety of campus seminars, campus field trips, and required internships for eleventh graders. AMES students have access to specialized counseling services from a community counseling center that provides a wide range of counseling services including self-esteem related programs. Physical and occupational therapy are also available. There is a Quantum Learning Study Skills Camp during the summer for incoming students, voluntary Saturday Advanced Placement (AP) preparation classes, and discounts for AMES students taking ACT preparation classes. Finally, there is an independent study section with computers for the approximately one-third of AMES students who do not have home computers or Internet access.

The Illinois Mathematics and Science Academy

At IMSA a strategy team, consisting of various staff members, meets regularly to review academic and residential progress and student performance records. The team examines intervention strategies for students experiencing difficulties and may recommend additional steps as necessary. IMSA employs a Learning Strategies Specialist and a Writing Specialist. Working with faculty and other support staff, the Learning Strategies Specialist designs and implements individual and group interventions for students with learning difficulties. She helps students with note taking, preparing for tests and written assignments, staying focused during volume reading, and managing time. The Writing Specialist and the writing center assist IMSA students in developing their writing skills and help faculty and staff with integrating writing into their instructional practice. The school also has a counselor and psychologist to aid students. Students may refer themselves to the counselor simply by signing up for an appointment. At other times, a concerned faculty member, staff, or parent may refer a student. Issues may include homesickness, anxiety, depression, family crises, stress, relationship problems, low self-esteem, and self-destructive behaviors such as drug and alcohol abuse or eating disorders.

Programs and Services at Other Schools

Other schools in the study also offer noteworthy special services or programs. Manhasset High School monitors students carefully and provides special classes for those experiencing difficulty. Every other day there are support classes for students who are in danger of failing classes such as Earth Science, Living Environment, chemistry, or mathematics. Those who appear unable to pass the New York Regents Examinations are placed in a support class. This class, which will be established for as few as three

students, provides additional instruction in the difficult subject. With this level of individual attention, the school reports very few failures on the state exams.

The Center for Advanced Studies at Wheeler has recently started an AVID (Advancement by Individual Determination) program. The national AVID program is an in-school support program that prepares students in grades five through 12 for college admissions and the successful completion of a post-secondary program. AVID claims to level the playing field for minority, low income, and rural students by placing average students in accelerated classes. At Wheeler the AVID program recruits ninth graders in hopes of attracting them to the magnet program by the tenth grade.

Programs Designed Specifically for Under Represented Students

Two schools, NCSSM and IMSA, have extensive programs for under represented students. Each is discussed here in detail:

- North Carolina School of Science and Mathematics
    - Throughout the school year NCSSM sponsors weekend activities that provide multicultural activities for current students and recruit new minority students. For example, there are the Native American Powwow, Asian Fest, African Fest, and Living the Dream weekends. These events feature a variety of activities (presentations, music, dance, ethnic food, etc.) that students help sponsor and participate in. Prospective students from across the state are invited to attend to learn more about the school and the program.
    - In addition, NCSSM tracks students' interests and responds with appropriate activities. For example, there are the Colours Gospel Choir and the Asian Cultures Club. Local families take interested students to church and out to eat on the weekends. The school sponsors awards for seniors that students can qualify for regardless of race, ethnicity, or gender. Finally, faculty and staff closely monitor students to head off possible problems. For example, there have been structured discussions regarding the appropriateness of African American students using the word "nigger."
- Illinois Mathematics and Science Academy
    - During the IMSA admission process, students are sometimes identified as having exceptional potential but lacking access to academic opportunities. The EXCEL program serves students who are conditionally admitted to IMSA, pending their successful completion of the EXCEL program. The three-week, residential program takes place during the summer immediately prior to the planned admission. EXCEL includes the three-week summer program and ongoing support programs throughout the year including: study groups, academic advising, connections with faculty, staff, and tutoring opportunities, cultural enrichment and appreciation activities, and an overall support network designed to help students succeed at IMSA. During the summer program, students engage in mathematics, science, and English classes designed to expose them to unfamiliar concepts critical to later success at the Academy. In addition, the co-curricular component

of EXCEL allows for interpersonal skill development and a chance to become familiar with IMSA.

- Beyond these three programs, IMSA maintains a culture that supports and values diversity in geography (rural vs. urban), race and ethnicity, gender, disability, religion, language, and socio-economic level along with diversity of thought. For example, celebrating a holiday that few others celebrate is not only accepted but valued. The emphasis is on biculturalism — not assimilation. The coordinator of multicultural recruitment and retention ensures that there are a variety of clubs that respond to students' interests and that they attend multicultural events in the Chicago area. This person is also responsible for multicultural awareness week (featuring presentations, dancing, music, games, and ethnic food) and a peer multicultural awareness program.

Features of the Curriculum

Attempting to compare the curricula of these eight schools is difficult for a number of reasons: the different number of years of schooling offered (two-four); the type of school (magnet, school-within-a-school, or regular high school); and the length of time the school has been in existence (starting the third year for the newest). Because of these factors and others such as student characteristics and curricular focus of the school, there is variation in the number and types of courses. Therefore, this report will not include an extensive analysis of the various curricula; only a few descriptive observations regarding the courses the schools offer (*See Table 3 below*). For a complete list of courses for each school, see Appendix A.

A review of the mathematics and science courses offered by these eight schools reveals the following:

- Depending on when students enter, all offer a full range of "basic" courses: algebra, advanced algebra and trigonometry, geometry, and calculus in mathematics and biology, chemistry, and physics in science. There may be different classes on the same subject, e.g., Informal Geometry, Euclidean Geometry, Honors Euclidean Geometry, and Magnet Euclidean Honors Geometry (from a school-within-a-school). Although the number varies greatly, all offer advanced classes such as Discrete Mathematics, Number Theory, Mathematical Modeling, and Fractals and Chaos. The same is true for science. For example, one of the open enrollment schools offers Biology, Honors Biology, and Advanced Placement (AP) Biology. Advanced courses offered by one or more schools include Anatomy, Physiology, Astronomy, Meteorology, Organic Chemistry, and Polymer Chemistry.
- All provide advanced placement courses in mathematics and science except AMES, which offers dual enrollment instead (*see below*). Preferring to structure what would normally be AP courses according to its core competency, IMSA offers a limited number of AP courses — AB and BC Calculus and AP Computer Science only.
- Including AP classes, all schools offer or will offer in 2006 classes for college credit. For example, AMES offers concurrent/dual enrollment in University of Utah courses

taught by college instructors in chemistry, physics for scientists and engineers, statistics, college algebra/trigonometry, and calculus on the AMES campus. AMES students can attend University of Utah science classes and labs at a reduced rate. A college biology class is planned for school year 2006-2007.

- All of the schools require a research project, mentorship, or internship. Involving students in research is a distinguishing feature of Manhasset. Students start in the eighth grade with an introduction to research class and can continue each year through graduation. About 15 percent of the student body is enrolled in a basic or advanced research class in mathematics, science, or social science. NCSSM believes in using the community as an extended classroom. Consequently, students may work in a lab somewhere in the Research Triangle in North Carolina, where the school is located.
- Each school emphasizes its use of certain instructional strategies. Some of those included cooperative learning, small learning communities, individualized learning plans, research, team projects, application and hands-on activities, and the infusion of technology. NCSSM stresses its individualized study; AMES, its portfolio assessment; and IMSA, its core competency, which includes instruction that is competency based, problem centered, inquiry based, and integrative.

Table 3: Highlights of the Specialty Schools' Mathematics and Science Curriculum

School/ Years of School/ Enrollment	No. of Math Courses Offered	No. of Science Courses Offered	No. of Computer Science Courses Offered	AP Courses Offered In M/S	Courses Offered for College Credit	Research Projects, Mentorships, or Internships	Instructional Techniques Emphasized
AMES/4/400	7	9	4	No	Yes	Yes Partnership with Univ. of Utah	Coop. learning, problem-based learning, portfolio assessment, writing across the curriculum.
Wheeler/4/400	12	22	4	Yes	Starting in the fall of 2006	Yes	Collaborative learning, heavy integration of technology.
Wilmington/4/934	12	25	8	Yes	Yes	Yes	Emphasis on quantitative and analytical skills.
Granada Hills/ 4/443	9	11	2	Yes	Yes Partnership with UC-Northridge	No	Emphasis on small learning communities.
IMSA/3/650	25	32	5	Limited	Yes	Yes	IMSA's core competency: competency based, problem-centered, inquiry based, and integrative. Personalized learning plans.
Manhasset/4/781	23	17	Will add in 2006	Yes	AP only	Yes	Heavy emphasis on research component and team projects.
Ocean Lakes/ 4/500	10	16	1	Yes	AP only	Yes	Emphasis on research and the infusion of technology.
NCSSM/2/620	37	51	5	Yes	Yes	Yes	Heavy emphasis on application and hands-on activities. Individualized study.

Interviews with School Administrators

The researcher conducted a telephone interview with a representative from each school. All interviewees were either the principals or other high level administrators in the school (*see Table 4*). The discussion focused on three questions:

- What characteristics make a principal most effective for a mathematics and science high school with a diverse population?
- What have you learned about meeting the needs of a diverse student body in a mathematics/science high school?
- What would you tell the superintendent of a large urban district regarding the setting up of science and mathematics programs for students who are likely to become technicians or engineers as well as scientists or mathematicians?

Table 4: Interviewees by Position within the Mathematics and Science Specialty High School

School	Position of Interviewee
AMES Charter High School	Principal
Center for Advanced Studies in Science, Math, and Technology at Wheeler High School	Program Director
The Charter School of Wilmington	President
Granada Hills Charter High School/CCSUN Math, Science and Technology Magnet	Principal
Illinois Mathematics and Science Academy	Principal
Manhasset High School	Principal
Mathematics and Science Academy at Ocean Lakes	Assistant Principal
North Carolina School of Science and Mathematics	Executive Vice-President for Academic Programs

The following text summarizes their answers by question:

- What characteristics make a principal most effective for a mathematics and science high school with a diverse population?
    - Flexibility: Three interviewees specifically mentioned flexibility. They said that principals need to switch gears very quickly to adapt to changing circumstances. Principals who have a very traditional orientation toward students and schooling will not be happy in a mathematics and science specialty school with a diverse student body. For example, a principal has to be very knowledgeable of school culture and respond to that culture to create a positive learning and teaching environment. Such an environment does not occur naturally; principals have to be very deliberate in its formation; and that requires flexibility. One interviewee mentioned hearing rumors that the magnet, school-within-a-school students were advocating for their own graduation, rather than graduating with their peers in the larger school. He quickly met with them, listened to their concerns, and was able to address their issues while maintaining one graduation.

- Appropriate background and orientation: Three interviewees emphasized the importance of the principal's background and orientation. He or she needs to have some background in mathematics and science, but preparation should go well beyond those two content areas. A generalist orientation is much more important. As one interviewee said, "There's much more to life than just mathematics and science." As instructional leader, the principal needs to know instructional design and effective teaching strategies. The goal of a mathematics and science specialty high school is to provide an outstanding education, with an emphasis on science and math, to students. It is not to prepare every student for a career as a scientist or mathematician. With a solid background, students will make their own choices, e.g., environmental law, economics, or culinary arts.
- Having a diverse staff: Two interviewees cited having a diverse staff as an important characteristic of an effective principal. A diverse school needs a diverse staff, and hiring such a staff is one of a principal's major challenges. Not only does the staff need to reflect the diversity of the students, faculty need to be content experts, be well grounded in effective instructional strategies, and have a sensitivity to the intellectual and emotional needs of a variety of students. They, along with other school staff such as counselors, need to be able to work effectively with students who are gifted and talented as well as those who are not.
- Other characteristics mentioned include: a knack for public relations; a dedication to lifelong learning; a high energy level and passion for leading a mathematics and science specialty school; and well developed and broad leadership skills.

- What have you learned about meeting the needs of a diverse student body in a mathematics and science specialty high school?
  - Appealing to students' interests: The most frequent response (five out of eight) to this question was developing programs that attracted students. One interviewee mentioned the need to provide a hook to interest students. He mentioned exploring the physics of a theme park as an example. Another cited the importance of having a "graduated curriculum." He mentioned developing a course especially for students who did not have a sound Algebra II background. There will be students who have undeveloped potential or talent, which can be developed only over time. All sorts of programs such as AVID, Learning Links, summer camps, and introductory courses that level the playing field can attract students and broaden their experience.
  - Attending to the culture of the school: Three interviewees stressed attending to school culture. The school must be a safe place for students to learn. One interviewee mentioned the two following slogans: "Rigor with support" and "Acceleration with assistance." One without the other will not work for a diverse student body. Another emphasized how deliberate attending to school culture must be. The academic program, the extracurricular program, and the dormitory program (for residential schools) all must be orchestrated. Things cannot be left to chance. Staying on top of culture means being accessible and having an open door policy, stressed one interviewee.

- What would you tell the superintendent of a large urban district regarding the setting up of science and mathematics programs for students who are likely to become technicians or engineers as well as scientists or mathematicians?
    - Start-up Activities: Five of the interviewees commented on the administrative aspects of establishing a new school. They suggested:
        - Making sure you know who your stakeholders are and that they agree on the nature of the school you are establishing;
        - Being clear about the target audience to be served;
        - Having a clear vision and keeping it simple;
        - Knowing what your community will support;
        - Hiring a strong faculty;
        - Starting small and building a school rather than taking on too much at one time; and
        - Developing a business plan and sticking to it.
    - One interviewee said that a major temptation in starting a new school is saying "yes" to good ideas that do not fit within the scope of your plans. Another stressed visiting other schools similar to the one you are interested in starting and getting advice from "those who have done it," especially so you do not "reinvent the wheel."
    - Programmatic Issues: Five interviewees commented on programmatic issues in establishing a new school. They emphasized the following:
        - Having a variety of courses: those for technicians and engineers as well as scientists and mathematician. Courses should appeal to students as well as their parents;
        - Being very student-centered rather than content-centered;
        - Emphasizing a pedagogy that incorporates hands-on activities and application of content;
        - Establishing a culture of biculturalism – not one of assimilation;
        - Putting the interests of students first;
        - Making sure that your curriculum produces what employers want: Students who can "think, read, write, talk, and work well together with their colleagues." Place emphasis on a strong education rather than preparing students to go into scientific or mathematical fields.

Four interviewees also mentioned the need to interest students in science and mathematics at a young age. Starting in the primary grades is not too early, certainly no later than the middle grades. Waiting until students are in the eighth or ninth grade means that potential talent may well be lost.

Twelve Recommendations for Strengthening Mathematics and Science Programs Serving a Diverse Population

Based on the data gathered and the interviews with administrators, the author makes the following suggestions. These twelve recommendations are targeted primarily toward educators wanting to strengthen their own mathematics and science offerings, possibly by establishing a school-within-a school or launching a charter school. The recommendations are listed in the order in which they should occur:

1. Conduct a market study before developing a plan. What is the need and interest in a mathematics and science specialty school in your area? Who is your target audience? What is the purpose of this new program or school? What will students be prepared for when they graduate? What resources exist for establishing and supporting such a program or school, and are these sufficient? Who will staff this program or school? Are these people available? How much community support exists for this new venture? What are the pitfalls, and how can they be overcome?

2. Have a broad-based planning group. Your planning committee for a specialty mathematics and science program should include educators, parents, students, community members, and representatives from business and industry and colleges and universities. Many of these individuals should be experts in fields related to your endeavor, e.g., finance, curriculum, architecture, human resource development, and post-secondary education. Such a group can provide you with the information you need to make wise decisions about your venture.

3. Develop a business plan. Although you are planning an expanded program or even perhaps a new school, you can profit from a business plan. Following a business plan will help keep you focused, as there likely will be requests that could pull you off track. And remember to start small, e.g., adding a class of students a year.

4. Make explicit your desire to have a diverse student body. Define diversity. Does it include racial and ethnic minorities, both males and females, persons with disabilities, and individuals from different geographic regions? Are you also looking for diversity of thought (religion, political perspective, cultural background)? Place your statement of commitment to diversity on all recruiting and marketing information so that it is prominently displayed. Use it as a frame of reference for making decisions about every aspect of your new venture.

5. Make an informed decision regarding open versus standard enrollment. Which admissions procedure will most likely produce the desired student body? Review the literature on open versus standard enrollment. Talk to schools that rely on open admissions. What is their track record in admissions and graduation rates? What does your community have to say about this issue?

6. Hire a principal who can deal effectively with a diverse student body and community. Not all principals are good candidates for heading up a mathematics and science specialty school. Your principal must be an outstanding role model for students, staff,

and the community. Effective principals need to be comfortable in interacting with students, parents, and community members of different racial/ethnic groups and socio-economic levels. They need to be flexible, able to switch gears quickly if a plan is not working. They need to be able to detect the pulse of their student body and detect problems before they develop. They need to understand and be committed to mathematics and science but not to the exclusion of other subjects and extracurricular activities. The goal of such a specialty school is to provide students with an outstanding education with an emphasis on mathematics and science. It is not to produce scientists or mathematicians. With good preparation, students are well prepared to make the choices that are best for them. High school is a time of exploration as well as preparation.

7. Hire a diverse staff committed to your vision and mission. The success of your venture depends heavily on your staff. Do they reflect the diversity of your student body? Are they strong content specialists able to inspire students? Are they able to work with students of different ability levels and learning styles? Are they sensitive to cultural differences among students? Are they open to new ideas and new instructional approaches? Do they value other subject areas — not just mathematics and science? Are they committed to holding students to high standards while providing them with the support necessary for them to achieve? Can they appreciate the role of extracurricular activities in students' lives? Are they collegial, willing to work with one another to develop a strong program?

8. Develop support programs and services that address the diversity within your school. Effectively meeting the needs of a diverse student body cannot be left to chance. Action needs to be deliberate on your part. There needs to be a number of programs and services that help students enroll and satisfactorily complete their program of study. Most likely these programs and services will help all students, but they will be designed specifically for students who may not be well prepared for a challenging mathematics and science curriculum.

9. Sponsor pre-programs at lower grade levels to interest students in mathematics and science careers. As this report indicates, some of these programs and services may need to start in elementary and middle school if students are to develop a strong base in mathematics and science and an interest in attending a specialty school by the time they reach high school. Sponsoring summer, Saturday, or after-school programs should guarantee a specialty school a steady supply of well-qualified applicants.

10. Develop a systematic approach to planning and implementing support programs for students. Rarely do schools systematically assess the nature of students' learning difficulties, which may be related to a myriad of factors, and then design interventions specifically designed to address the difficulty. Usually support programs are fragmented and uncoordinated. Would a particular student profit best from peer tutoring, teacher tutoring, participation in AVID, or other programs or services? How does a teacher or counselor know? Schools can contribute to students' success by having procedures in place to diagnose the nature of learning difficulties and then

having a coordinated set of programs and services in place that can remedy these problems[3].

11. Develop your curriculum based on the requirements of post-secondary institutions, the expectations of the business and industrial community, and the interests of the students. Obviously, you want your students to be well prepared for college admission. You also want students not headed for four-year institutions to be well prepared for community college or the on-the-job training they may receive from employers in your area. At the same time, you want your courses to appeal to the interests of the students. Forensics, game theory, fractals and chaos, evolution, robotics, research projects, and a variety of courses related to marine science are likely to attract students based on their interests and their geography. Students may also be interested in taking Advanced Placement courses, courses for college credit, and/or courses leading to an International Baccalaureate Degree.

12. Gather data on the effectiveness of your programs and services, and make sure that the data are disaggregated on the basis of the diversity represented in your student body. What is the effect of participating in AVID? Do students get better grades? Do students who participate in a summer program prior to starting your program do better than those who do not? What students are using the various tutoring programs, and how are they benefiting? Are racial and ethnic minority students participating in extra-curricular activities? If so, which ones? What is the graduation rate for each group? What are the two- and four-year college completion rates for your students? What careers do your students eventually go into? Having such data will allow you to assess the entire range of programs that you offer and make adjustments accordingly. They also provide you with data on the overall effectiveness of your school.

[3] An excellent resource on establishing support programs for students is *The School Leader's Guide to Student Learning Supports* (2006) by Howard S. Adelman and Linda Taylor. It is available from Corwin Press, Thousand Oaks, California.

APPENDIX A

Listing of Courses by School 2005 – 2006[4]

Academy for Math, Engineering, and Science (AMES)	Center for Advanced Study at Wheeler High School
Mathematics Elementary Algebra Intermediate Algebra Geometry Pre-Calculus Calculus 1210/1220 – University of Utah College Algebra/Trigonometry 1050/1060 – University of Utah Statistics 1070 – University of Utah	Mathematics Honors Magnet Euclidean Geometry Honors Magnet Algebra II Advanced Algebra and Trigonometry Honors Magnet Analysis (Pre-Calculus) Honors Calculus AP Statistics AP Calculus (AB) AP Calculus (BC) Math Modeling Multi-Variable Calculus Calculus II (Will be offered Fall 06 via video conferencing with Georgia Tech) Calculus III (Will be offered Fall 06 via video conferencing with Georgia Tech)
Computer Science Computer Technology C++ - Salt Lake Community College Multimedia Programming and Robotics	Computer Science Introduction to Computer Programming Advanced Programming and Gaming Projects Oracle AP Computer Science
Science Earth Systems Honors Biology General Chemistry Anatomy Geology Physics 2210/2220 – University of Utah Chemistry 1210/1220 – University of Utah Chemical Engineering 4975-025 – University of Utah Biology 1210/1220 (to be taught SY 06-07)	Science Magnet Foundations Science, Technology, & Society Honors Magnet Biology I Honors Magnet Forensics/Biochemistry AP Biology Advanced Genetics/DNA Research (Post-AP) Honors Magnet Chemistry I Honors Magnet Chemistry II AP Chemistry Chemical Engineering and Materials Science (Post-AP) AP Environmental Science Honors Magnet Physics I Magnet Honors Physics II (Engineering Physics) AP Physics B AP Physics C Advanced Physics/Robotics Principles (Post-AP) Human Anatomy and Physiology Astronomy Zoology Advanced Magnet Science Internship (Post-AP) Advanced Magnet Scientific Research (Post-AP) Advanced Physics/Robotics Chemical Engineering and Materials Science
	Engineering Technology Introduction to Engineering Drawing I

[4] Descriptions of most of these courses may be found on the schools' websites.

	Engineering Concepts and Drawing Architectural Drawing and Design I Architectural Drawing and Design II Solid Modeling and Design Technical Manufacturing Concepts Introduction to Electronics I Electronics II Electronics III Electronics IV – Telecommunications Pre-Engineering Technology Engineering Applications Research and Development Robotics Engineering
	Information Technology Webpage Design Digital Media Design Digital Media Technology Multimedia Presentations and Communications Video Productions I Video Productions II Video Productions III Video Productions IV IT Foundations IT User Support Networking Operating Systems Management

The Charter School of Wilmington	**Granada Hills Charter High School**
Mathematics Integrated Mathematics I, II and III Discrete Mathematics with Applications History of Mathematics Pre-Calculus Calculus Concepts AP Calculus AB AP Calculus BC AP Statistics University of Delaware Math 243 (previously known as Calculus 3) University of Delaware Math 302: Ordinary Differential Equations	Mathematics Algebra I Geometry Algebra II Honors Algebra II/Trigonometry Math Analysis AP Calculus Discrete Math AP Statistics AP Computer Science
Science Introduction to Chemistry Introduction to Physics Geosystems Biology Digital Electronics Design Lab Astronomy Essential of Oceanography Human Life Cycle Part I and II Chemistry (college prep) Introduction to Engineering Environmental Science Biogenetics Introduction to Robotics	Science Science 9 Biology Honors Biology Chemistry Honors Chemistry AP Biology AP Chemistry Physics Honors Physics AP Physics Physiology

Forensic Science Introduction to Anatomy and Physiology Physics (college prep) Laboratory Assistant Modern Physics Senior Research Project AP Biology AP Chemistry AP Physics AP Environmental Science University of Delaware Chemistry: Survey of Organic Chemistry	
<u>Computer Science</u> Technology Utilization Data Analysis Programming in Java Computer Graphics Engineering Drawing Web and Network Programming AP Computer Science University of Delaware: Data Structures	

Illinois Mathematics and Science Academy (IMSA)	**Manhasset High School**
<u>Mathematics and Computer Science</u> Geometry I/II Mathematical Investigations I, II, III, and IV AB Calculus I and II BC Calculus I, II, and III Advanced Geometry Data Analysis Differential Equations Exploring Mathematics with Mathematica Multi-Variable Calculus Number Theory Problem Solving Advanced Problem Solving Discrete Mathematics Introduction to Algebraic Structures I and II OPTION I: Linear Algebra OPTION 2: Abstract Algebra Advanced Topics in Mathematics Introduction to Visual Basic Introduction to Computer Science AP Computer Science Computer Seminar Assembly Language Programming	<u>Mathematics</u> Mathematics Research I and II Mathematics Research Advanced Mathematics 9 and 9X* Mathematics 9 Honors Mathematics 10 and 10X Mathematics 10 Honors Mathematics 11 and 11X Mathematics 11 Honors Pre-Calculus College Calculus Pre-Calculus Honors AP Calculus AB AP Calculus BC AP Statistics Calculus Mathematics 9A Mathematics 10A Mathematics 11A Mathematics 12A *X = Support classes for students enrolled in the main class
<u>Science</u> Scientific Inquiry – Chemistry Scientific Inquiry – Physics Scientific Inquiry – Biology Methods in Scientific Inquiry Applied Engineering Survey of Organic Chemistry Organic Chemistry I and II	<u>Science</u> Physical Setting: Earth Science Regents Physical Setting: Earth Science X Living Environment Living Environment X Living Environment Honors Physical Setting: Chemistry Physical Setting: Chemistry X

Biochemistry Facets of Thermodynamics Advanced Chemistry: Matter and Molecules Advanced Chemistry: Reactions and Qualitative Analysis Calculus-based Physics: Mechanics Calculus-based Physics: Electricity and Magnetism Astrophysics Observational Astronomy Electronics Modern Physics Advanced Physics – Motion and Forces Advanced Physics – Waves and Fields Ecology Human Anatomy and Physiology General Microbiology Pathogenic Microbiology Genetics Patterns of Biological Diversity Plants and People Biotechnology Applied Engineering Junior Research in Science Senior Research in Science Science, Society, and the Future	Physical Setting: Chemistry Honors Environmental Science Forensic Science Physical Setting: Physics AP Physics AP Biology AP Chemistry Scientific Research Advanced Scientific Research Siemens and Intel Preparation

Mathematics and Science Academy at Ocean Lakes High School	**North Carolina School of Science and Mathematics (NCSSM)**
<u>Mathematics</u> Algebra 3 Precalculus and Modeling Precalculus and Modeling with Advanced Topics Finite Mathematics Advanced Algebra Applications Explorations in Advanced Geometry Statistics I, II, and III Calculus (AP) I, II, and III Calculus with Advanced Topics (AP) I, II, and III Calculus 2 with Advanced Topics – Turbo (AP) Statistics with Advanced Topics (AP) I, II, and III Explorations in Advanced Geometry with Topics Modeling with Differential Equations Numerical Analysis Number Theory Combinatorics and Game Theory Graph Theory and Networks Mathematics Proof and Structures Mathematical Modeling Fractals and Chaos Vector Functions and Partial Derivatives Multiple Integrals and Vector Fields Advanced Mathematical Topics	<u>Mathematics</u> Magnet Advanced Algebra Magnet Geometry Magnet Precalculus I and II Magnet Data Analysis)* Magnet Mathematical Modeling* AP Calculus AB or BC * Magnet Multivariable Calculus* Magnet Differential Equations * Magnet Computer Architecture* *Weighted courses that have college-level objectives, textbooks, and supplementary materials.
<u>Science</u> Biology Anatomy and Physiology	<u>Science</u> Magnet Chemistry Magnet Molecular Biology*

Classical Genetics
Molecular Genetics
Embryology
Evolution
Ecology
Advanced Evolution
Molecular and Cellular Biology
Human Physiology
Immunology
Environmental Science (AP) I and II
Advanced Biology (AP) I, II, and III
Research in Biology I, II, III, and IV

Chemistry

Chemistry
Chemistry with Advanced Topics
Web AP Chemistry
Chemistry with Advanced Topics (AP)
Advanced Chemistry (AP) I and II
Organic Chemistry
Environmental Chemistry
Polymer Chemistry
Research in Chemistry I, II, III, and IV

Physics

Physics I and II
Applied Electronics
Introduction to Robotics
Physics with Advanced Topics I and II
Advanced Robotics
Physics II – Mechanics (AP-C)
Physics II – Electricity and Magnetism (AP-C)
Advanced Physics II – Mechanics (AP-C)
Advanced Physics II – Electricity and Magnetism (AP-C)
Astrophysics
Advanced Modern Physics
Research in Physics I, II, III, and IV
Advanced Topics in Physics

Magnet Physics*or AP Physics B*
Magnet Human Anatomy*
Magnet Human Physiology*
Magnet Astronomy*
Magnet Meteorology*
Magnet Analytical Chemistry*
Magnet Organic Chemistry*
Magnet Microbiology*
Magnet Biochemistry*
Magnet Physical Geology*

*Weighted courses that have college-level objectives, textbooks, and supplementary materials.

Computer Science

Introduction to Procedural Programming
Intermediate Programming (AP)
Advanced Programming (AP)
Advanced Object-Oriented Programming in C++
Advanced Computer Science Topics

Technology

Magnet Foundations of Technology
Magnet Materials of Science
Magnet Electrical Engineering
Magnet Multimedia Communications
Senior Research Project or Mentorship
Other recommended courses are AP Statistics, AP Computer Science, AP Chemistry, AP Physics C, AP Biology, and AP Environmental Science.

APPENDIX B

Profiles of the Schools Participating in this Study

What follows is a profile of each of the eight schools participating in this study of mathematics and science specialty schools serving a diverse student population. The profiles were intended to provide a quick overview of the school – information such as name, address, contact information, type of school, enrollment, mission, admissions procedures/description of the student body, persistence rate, and the sequencing of courses. The profiles are not identical as all schools did not necessarily provide the same data.

For additional information, visit each school's web site or contact the individual listed in the profile.

PROFILE

ACADEMY FOR MATH, ENGINEERING, AND SCIENCE CHARTER HIGH SCHOOL

Name of school:	Academy for Math, Engineering, and Science (AMES)
Address:	5715 South 1300 East, Salt Lake City, UT 84121
Telephone:	801.278.9460
URL:	http://ames-slc.org
Contact:	Dr. Al Church, Principal and CEO, Achurch@ames-SLC.org
Type of school:	Public charter high school in partnership with Granite School District, Salt Lake City School District, and the University of Utah
Year established:	2003-2004
Day or residential:	Day
No. of students:	400
Years of education provided:	4 (School is in its third year.)
Mission:	AMES was established to provide a choice for students with a particular interest in math, science, and/or engineering. The school's specific purpose is to prepare a diverse student body for early college entrance by focusing on the following: rigor, relevance, and relationships.
Admissions procedures/ description of the student body:	Students are selected by a lottery. The school recruits every 8th grader. The applicant pool is very large to get the diversity desired. Student slots are allocated to mirror the overall student demographics of the 14 high schools in the districts where students live. Racial/ethnic and gender composition of the student body: Caucasian – 67%; Hispanic – 20%; Pacific Islander – 5%; Asian – 4%; African American – 3%; American Indian/Alaskan Native – 1%. Male – 53% and female – 47%. The best student body will be one with differing ideas and backgrounds from which everyone can learn. The school is not looking for students with 4.0 GPA – staff wants all students who are eager, interested, and motivated to apply. There is no entrance examination. After acceptance, students' interests and abilities are assessed in conjunction with staff and parents to determine course readiness and placement.

Persistence rate: Approximately 90%

Pathways:

	9	10	11	12
Math	Elem. Algebra	Geometry	Algebra II	Pre-Calculus
	Geometry	Algebra II	*Calculus	*Calculus
			*Statistics	*Statistics
			*College Algebra/Trig	*College Algebra/Trig
			Pre-Calculus	
Science	Earth Systems	Honors Biology	General Chemistry	Physics
	Honors Biology		*College Chemistry	*College Physics
			*College Biology	*College Chemistry
			Geology	*College Biology
			Anatomic/ Physiology	Geology
				Anatomic/ Physiology

*University of Utah classes. Non-University of Utah courses align with recommended Utah State Board of Education.

Comments: AMES is one of Utah's 6 early college high schools supported in its planning state by a matching grant from the Bill and Melinda Gates Foundation and the Utah legislature (2002-2003). This initiative was proposed by then Governor Michael Leavitt in collaboration with public, higher education, and private sector stakeholders. Each high school adheres to the essential elements of early college high schools (attracting and serving traditionally underserved high school students with a college readiness curriculum in partnership with a higher education institution). Each of the Utah schools has a math, science, and technology focus with anticipated outcomes of attracting more high school graduates to pursue college studies in math, science, and technology.

PROFILE

CENTER FOR ADVANCED STUDIES IN SCIENCE, MATH, AND TECHNOLOGY AT WHEELER HIGH SCHOOL

Name of school:	Center for Advanced Studies in Science, Math, and Technology at Wheeler High School
Address:	375 Holt Road, Marietta, GA 30068
Telephone:	770.578.3286
URL:	www.wheelerhigh.com
Contact:	Greg Farmer, Program Director, Gregg.Farmer@cobbk12.org
Type of school:	Public specialized magnet
Day or residential:	Day
No. of students:	400
Years of education provided:	4
Admissions procedures/ description of the student body:	Center attempts to recruit from a broad base of students. The admissions procedure considers grades, standardized test scores, admissions test scores, interest and aptitude in mathematics and science, communication skills, and recommendations. Racial/ethnic and gender profile: White – 67.8%; Asian – 16.2%; African-American – 10.6%; Hispanic – 2.3%; and multiracial – 3.1% (data are for in-district students only). Males – 61.3% and females – 38.7% (both in-district and out-of-district students).
Persistence rate:	89.24%
Special services:	After-school peer and teacher tutoring.
Programs/ Strategies:	The school has recently added an AVID program. There is also a Learning Links after-school tutoring program. The Center promotes a culture of learning through a variety of academic competitions including FIRST Robotics, BEST Robotics, Science Olympiad, Biology Olympiad, Chemistry Olympiad, Academic Bowl, Science Bowl, Math Team, Debate, and Odyssey of the Mind.

Pathways: All magnet students take a magnet foundations course called Science, Technology, and Society in their freshmen year. All magnet students are required to double in science each year. The sequence begins with Magnet (Honors) Biology and Chemistry in the freshman year. In the sophomore year, all students take Magnet Physics and choose a second course between Chemistry II (pre-AP), Physics II (Engineering Physics), or Biochemistry/Forensics. In the junior year, students take either 1 AP science and 1 post-AP science or 2 AP sciences. The post-AP sciences were created by the Center for the state and include Advanced Physics/Robotics, DNA Genetics Research, or Chemical Engineering. In the senior year, all students take a post-AP Scientific Research and post-AP Scientific Internship course.

In math, all students exit the program with a minimum of Honors Calculus. The tracking is determined by where they enter the program and their performance. Those who go the highest route take AP Calculus AB and AP Calculus BC in their junior years and a post-AP Multivariable Calculus in their senior year. There is also an elective AP Statistics course, which most students take in either their sophomore or junior year and a Math Modeling course, which is a post-Calculus course.

Non-AP students may take Honors Anatomy and Physiology, Astronomy, Physics II, Chemistry II, Biochemistry/Forensics, and Math Modeling in the areas of mathematics and science. The Center also offers an array of technology-related electives including Engineering Drafting, Electronics, Computer Programming, Digital Design, and Multimedia Production.

Comments: The Center strongly emphasizes technology-based instruction, collaborative learning, and research. Students culminate their studies with a senior year Internship and Research program with universities, businesses, and institutions in the metro Atlanta area.

PROFILE

THE CHARTER SCHOOL OF WILMINGTON

Name of school:	The Charter School of Wilmington
Address:	100 North DuPont Road, Wilmington, DE 19807
Telephone:	302.651.2727
URL:	www.charterschool.org
Contact:	Ron Russo, rrusso@charterschool.org
Type of school:	Independently operated public school
Day or residential:	Day
No. of students:	934
Years of education provided:	4
Admissions procedures/ description of the student body:	About 55% of the student body is gifted and talented. Students are placed in one of 3 ability groupings: college prep – average ability; college prep – above average ability, and college prep – very high ability. Application includes recommendations, report cards, and results of national standardized tests. Students also take a placement test. The racial/ethnic/gender breakdown of the student body is as follows: Caucasian – 72%; Asian – 19%; African American – 7%; Hispanic – 2%. Males – 53.3% and females – 46.6%.
Persistence rate:	About 6.5% of students transfer to other local schools from grade 9 to graduation. Approximately another 3% transfer out of state (family moved) or enter college early.
Special services:	This school offers student-to-student assistance; every Wednesday peer leaders offer tutoring in all subjects after school. Teachers also help after school, and the school hires outside tutors from a company called "Back to Basics."
Programs/ Strategies:	The Charter School recognizes and celebrates academic achievement. Students participate in many academic competitions (Math League, Science Olympiad, Science Fairs, Mock Trial, and Academic Bowls) and also go to regional and national competitions if they qualify. The school awards JV letters (similar to athletic letters) to students who earn second

or a combination of first and second honors all year and a Varsity letter for earning all first honors. There is an annual awards banquet to give recognition for student performance in academic competitions and to give "Rising Star" awards for various accomplishments.

Pathways: Introduction to Chemistry (.5 credits); Introduction to Physics (.5 credits); Geosystems (.5 credits); biology, chemistry, and physics. Students can test out of the introductory courses as well as Geosystems and begin with biology and select another science course for their fourthcredit.

Integrated Math 1, Integrated Math 2, Integrated Math 3, pre-Calculus or Calculus. About 35% of the entering students test out of Math 1 and take Math 2 or higher mathematics course. Students can take a special math course during the summer at Delaware Technical and Community College and skip Math 3 and go into calculus.

Comments: Because some of the Charter School's students are highly advanced, arrangements have been made with the University of Delaware to send an instructor to the school and teach some of their courses on site. Last year, students took UD Math 243 (Calculus 3) and UD Math 302 (Differential Equations), both one semester courses. Students earned 4 college credits for each course. Survey of Organic Chemistry 1 and 2 were also offered for an additional 6 college credits. This year, Drexel University is teaching an Introduction to the Art of Engineering for 9 credits.

PROFILE

GRANADA HILLS CHARTER HIGH SCHOOL/CSUN MATH, SCIENCE AND TECHNOLOGY MAGNET

Name of school:	Granada Hills Charter High School/CSUN Math, Science and Technology Magnet
Address:	10535 Zelzah Avenue, Granada Hills, CA 91344
Telephone:	818.360.2361
URL:	www.granadahillshighschool.com
Contact:	Melanie Taylor, counselor, ext. 305, mtaylor@ghchs.com
Type of school:	Largest charter school in the country (Magnet School is part of the larger Charter School)
Day or residential:	Day
No. of students:	443
Years of education provided:	4
Admissions procedures/ description of the student body:	School seeks to promote achievement in mathematics and science among under represented minority students, young women, and deaf and hard-of-hearing students from the LA Unified School District. School has an open enrollment policy with interest in attending as a key factor. The racial/ethnic makeup stays at 60% ethnic/40% white. School has a high level of rigor with a waiting list of 1,000.
Persistence rate:	Over the past 11 years of the program, over 85% of the students enrolled in the program have completed it by graduating. Other students have moved to other cities/schools with the vast majority of them graduating as well.
Special services:	The school provides tutoring at lunch as well as after school in mathematics, science, English, and foreign language. In addition, a Saturday school program is in effect to specifically help students with mathematics and English study skills.

Programs/ Strategies: The Magnet Program fosters a culture of learning among its students. Magnet students are required to take at least three magnet classes each semester. Students work together on class projects; and because it is a small learning community, the magnet students and teachers form a rather tight-knit group. The magnet students spur each other on to do their very best.

Pathways:

Freshman	Credits for promotion to next grade level: 55 English 9A/B Algebra 1A/B, Geometry A/B, or Algebra 2A/B Foreign Language Science 9A/B or H Biology A/B Health/Life Skills Physical Education/Marching Band/Sports
Sophomore	Credits for promotion to next grade level: 110 English 10 A/B Next Math Level-Geometry A/B, Algebra 2A/B, Algebra 2 A/B/Trigonometry, Math Analysis A/B Foreign language Biology A/B or other Science World History A/B Physical education
Junior	Credits for promotion to next grade level: 170 American Literature/Comp. Next Math Level-Algebra 2A/B, Math Analysis Calculus Chemistry/Advanced Physical Science Foreign language or Technical/Fine Art* US History A/B Elective Digital Imaging
Senior	Credits for graduation: 230 English Literature/Comp. Next Math level Physics or other Science US Government/Economics Elective Elective Animation

Comments: The Math/Science Magnet program at Granada Hills Charter High School is a successful, college preparatory, voluntary integration program. It is successful in integrating students of different ethnicities from various socio-economic backgrounds as well as academic abilities.

PROFILE

ILLINOIS MATHEMATICS AND SCIENCE ACADEMY

Name of school:	Illinois Mathematics and Science Academy (IMSA)
Address:	1500 West Sullivan Road, Aurora, IL 60506-1000
Telephone:	630.907.5053
URL:	www.imsa.edu
Contact:	Eric McLaren, ericmac@imsa.edu
Type of school:	State supported magnet
Day or residential:	Residential
No. of students:	650
Years of education provided:	3
Admissions procedures/ description of the student body:	Gifted and talented Illinois students enrolled in the equivalent of a 9th-grade program are eligible to apply. Admission is competitive. Selection criteria include demonstrated interest and talent in mathematics and science, grades, teacher recommendations, a current SAT I score report, personal essays, leadership and co-curricular activities. The SAT I, GPA, and written application are weighted equally. IMSA enrolls 650 students from throughout Illinois, with the following demographic profile: • 67% from Chicagoland/metropolitan area; 33% from the rest of Illinois. • Male – 50%; Female – 50%. • White – 45%; Asian American – 36%; African American – 7%; Latino/a – 6%; Native American – <1%; Multi-racial – 4%; and Not reported/other – 2%. • Mean ACT composite score for IMSA's Class of 2004 ranked in the top one percent nationwide out of more than 9,000 schools with 30 or more seniors who took the ACT exam. • Mean ACT composite score for IMSA's Class of 2004 was 30.0, 9.1 points above the national average for college-bound seniors. The SAT score for the class of 2004 was 1370.

Persistence rate: Percent of students completing the program:

Completion rate	2002	2003	2004	2005
Overall	87.2%	86.4%	86.9%	87.4%
Female	86.7%	87.3%	89.6%	89.8%
Male	87.6%	85.5%	84.2%	85.0%
African American	91.3%	77.8%	84.0%	80.0%
Asian American	95.3%	96.3%	100.0%	95.6%
Latino/a	74.1%	100.0%	100.0%	85.7%
White	87.0%	80.7%	80.2%	83.7%

Special services: IMSA offers a full range of services to students to support their adjustment to and success at the school. For example, each student is assigned a College Academic Counselor upon enrollment. In addition, a Strategy Team, consisting of various staff members, meets periodically to review academic and residential progress and performance records of students. The team reviews intervention strategies for students experiencing difficulties and may recommend additional steps as necessary.

IMSA has a Learning Strategies Specialist and a Writing Specialist to assist students with study skills and writing. In addition, the school has counselors and a psychologist to assist students. Counselors are available to provide personal counseling to a struggling student, as well as consultation to parents and staff. Students may refer themselves to the counselor simply by making an appointment. At other times, a concerned residence counselor, staff member, or parent may refer a student. Difficulties may include: homesickness, anxiety, depression, inability to concentrate, family crises, stress, relationship difficulties, low self-esteem, and self-destructive behaviors.

Programs/ Strategies: IMSA sponsors 3 programs designed to promote the acceptance and success of students at its schools. These include Summer Enrichment for Academics in Mathematics and Science (SEAMS), a two-week enrichment program for students completing the 8th grade and who are considering applying to IMSA. The Early Involvement Program (EIP) serves students in the 9th grade. This enrichment program is held in Chicago on the campus of DePaul University for 10 Saturdays, November through March. It is designed to help under represented and economically disadvantaged students improve their mathematics, science, and English skills and prepare them for the SAT administered at the end of the program. The Excel program serves students who are identified as having exceptional potential but have not had access to key academic opportunities and are admitted to IMSA on a conditional basis. In addition to these 3 programs, IMSA works to maintain a culture that supports and

values diversity in geography, race and ethnicity, gender, disability, religion, language, socio-economic level, and diversity of thought.

Pathways: The core mathematics program consists of geometry, the Mathematical Investigations (MI) sequence, and calculus. New students who have not completed geometry begin their math sequence with Geometry I/II. MI is a sequence of courses in advanced algebra, trigonometry, and pre-calculus topics. The MI sequence for most new students begins with MI I/II, MI II, III, or IV depending on their IMSA math placement score and their home school preparation. MI I/II is a course designed to accelerate those students who have serious deficiencies in their math preparations. Completion of the MI sequence or a demonstrated competency in the subject matter of those courses allows students to enroll in Calculus A/B (two semesters) or B/C (three semesters). Completion of the mathematics core program allows students to enroll in a large number of advanced math and computer science electives.

The core science program consists of 4 one-semester courses: Scientific Inquiries (SI) – Physics, SI – Chemistry, SI – Biology, and Methods in Scientific Inquiry. All students are required to complete Methods in Scientific Inquiry, a course which explicitly addresses three broad skills areas encompassed by the nature of science: data acquisition and analysis, experimental design, and written and oral communication. Students new to IMSA who demonstrate an exemplary past academic record in biology, physics, or chemistry may choose to take a placement exam in that particular subject. A satisfactory placement exam score will demonstrate competency in the subject matter of that particular course, and the student will then be enrolled in an appropriate elective course. Completion of the science core program allows students to enroll in a large number of electives in earth/space science, biology, chemistry, physics, and applied sciences.

Comments: IMSA's core competency is the ability to conceive, design, develop, and demonstrate exemplary competency-driven teaching and learning experiences and materials that are inquiry-based, problem-centered, and integrative.

IMSA offers more than 100 advanced courses in mathematics, science, and the arts and humanities, with an emphasis on meaningful connections and integration. Personalized Learning Plans increase opportunities for students to deepen and strengthen their three-year academic experience. These plans also enable seniors to engage in learning unique to their interests and goals. The innovative Student Inquiry and Research Program enables students to pursue compelling questions of interest, conduct research and present findings, engage in entrepreneurial applied science and technology activities, and collaborate with other students, mentors,

scholars, researchers, and inventors throughout the world. To promote collaboration, IMSA does not calculate grade point averages or class rankings. Multiple assessment tools measure student learning – what students know and what they can do; examples include performance demonstrations, thinking logs, learning journals, and portfolios.

PROFILE

MANHASSET HIGH SCHOOL

Name of school:	Manhasset High School
Address:	200 Memorial Place, Manhasset, NY 11030
Telephone:	516.267.7600
URL:	www.manhasset.k12.ny.us
Contact:	William Stark, Principal, William_Stark@manhasset@k12.ny.us
Type of school:	The only community-based high school with this particular type of science and technology program in the country. (Manhasset is the only school belonging to NCSSSMST that serves a local attendance area.)
Day or residential:	Day
No. of students:	781 (entire school)
Years of education provided:	4
Admissions procedures/ description of the student body:	Students living in this attendance area go to this school. Socio-economic levels of the students tend to be split between very high and very low. The racial/ethnic enrollment data of the entire school for 2004-2005 is as follows: Caucasian – 74%; Asian – 14%; African American – 6%; Hispanic – 6%.
Persistence rate:	About 95% of all students go on to some sort of post-secondary education. For the research program, between 25 and 40 students enter the science research component in the 9th grade. In grade 12, 5-15 students remain and enter the major competitions.
Special services:	School provides support classes for students experiencing difficulty. Classes may be established for as few as 3 students and meet every other day. They are specifically designed for students who are in danger of failing Earth Science, Living Environment, or chemistry classes.
Programs/ Strategies:	Students can enroll in research projects for up to 5 years (starting with a middle level program that teaches the basics of research in the 8th grade). Beginning in the 9th grade, students take Scientific Research followed by 1 or 2 years of Advanced Scientific Research. Seniors take an Intel Prep course to prepare Siemens-Westinghouse and Intel STS entries. Most

students who complete the Introduction to Social Science Research continue on to Advanced Social Science Research and Intel Prep. Fifteen students from the class of 2005 participated in the Intel Science Talent Search. The research includes a tremendous amount of mentoring and individualized instruction. Since the teachers in the Social Science Research program approach all levels of research as a team, students often receive help and guidance from two teachers.

Pathways: Typical Course Selection by Year (Science)

Freshman	ID Life Science Physical Setting/Earth Science Regents Earth Science X Living Environment Regents Living Environment Honors Scientific Research
Sophomore	ID Living Environment Living Environment Regents Living Environment Honors Living Environment X Physical Setting/Chemistry Regents Physical Setting/Chemistry Honors Scientific Research Advanced Scientific Research
Junior	Physical Setting/Chemistry Regents Physical Setting/Chemistry Honors Chemistry X AP Chemistry (not offered in 2006-2007) Physical Setting/Physics Regents AP Physics Environmental Science Science Research Advanced Scientific Research
Senior	Physical Setting/Physics Regents AP Physics AP Biology AP Chemistry (offered every other year) Forensic Science Scientific Research Advanced Scientific Research Siemens and Intel Prep/Science Research
Electives are Forensic Science and Environmental Science along with the research courses.	

Typical Course Selection by Year (Mathematics)	Depending on their interests and abilities, students choose different sections of math to take in the 9th and 10th grades. Advanced students then choose from Pre-Calculus H, AP Statistics, or Pre-Calculus at the 11th grade. Offerings at the 12th grade are Calculus BC, Calculus AB, AP Statistics, and Calculus. Students may also enroll in Mathematics Research I/II.

PROFILE

MATHEMATICS AND SCIENCE ACADEMY AT OCEAN LAKES HIGH SCHOOL

Name of school:	Mathematics and Science Academy at Ocean Lakes High School
Address:	885 Schumann Drive, Virginia Beach, VA 23454-6878
Telephone:	757.721.4110
URL:	www.oceanlakeshs.vbschools.com
Contact:	Dr. Carolyn M. Keen, Assistant Principal, Mathematics & Science Academy, Carolyn.Keen@VBSchools.com
Type of school:	Public Academy (a school-within-a-school)
Day or residential:	Day
No. of students:	500
Years of education provided:	4
Admissions procedures/ description of the student body	The Academy is composed of both identified and non-identified gifted students. The academy offers a rigorous college preparatory curriculum and seeks students with a strong interest and proficiency in mathematics and science and who are academically motivated and dedicated to extending their knowledge beyond the typical high school curricula. Applicants must submit recommendations, transcripts, report cards, and standardized test scores. They must also take an entrance test and submit a writing sample. The racial/ethnic enrollment for 2004-2005 follows: Caucasian – 73.9%; Asian – 9.9%; Black – 6%; Hispanic – 3.2%; American Indian – 0.4%; Native Hawaiian/Pacific Islander – 1.0 %; unspecified – 4.7%.
Persistence rate:	The retention rate for the program is 97%, based on the total population. For the last 3 years, more than 400 students have applied for the available 125 slots, making acceptance into the program competitive. All of the graduates continue their education after high school, with 97% doing so in a four-year college or university.
Special services:	Tutoring is available for students who are having difficulty.

Programs/ Strategies: The Ocean Lakes staff incorporates interdisciplinary units of instruction whenever possible. Some math and science courses (for example, Multivariable Calculus, Differential Equations, and AP Physics C) are taught as double-block, combined sessions, with the 2 teachers working as a team. In addition, students must complete a one-credit senior mentorship or research project in order to graduate from the Academy. Preparation for this project begins with 9th grade courses and continues each year.

Pathways: Typical Course Selection by Year (Science)

Freshman	Magnet Honors English 9 Magnet Advanced Algebra or Magnet Pre-calculus Magnet Chemistry World Geography or World History Part 1 foreign language Health/PE 1 Optional elective
Sophomore	Magnet Honors English 10 Magnet Geometry or Magnet Pre-calculus or AP Calculus AB or BC Magnet Molecular Biology World History Part 2 or AP European History or AP Human Geography foreign language Health/PE 2 Optional elective
Junior	Honors English 11 or AP English Language and Composition Magnet Pre-calculus or Magnet Data Analysis & Math Modeling or AP Statistics or AP Calculus AB or BC Magnet Physics or AP Physics B US History or AP US History Magnet Foundations of Technology Elective Magnet Technology course Foreign language Optional elective
Senior	Honors English 12 or AP English Literature and Composition Magnet Data Analysis & Math Modeling or AP Statistics or AP Calculus AB or BC or Multivariable Calculus and Differential Equations Magnet science electives VA & US Government or AP US Government & Politics Optional electives

	Senior Research Project/Mentorship
Course electives	
Science electives:	Magnet Analytical Chemistry Magnet Organic Chemistry Magnet Biochemistry Magnet Microbiology Magnet Human Anatomy Magnet Human Physiology Magnet Physical Geology Magnet Astronomy Magnet Meteorology AP Physics C
Math Electives:	Multivariable Calculus & Differential Equations Magnet Math Modeling and Data Analysis Magnet Computer Architecture
Technology electives:	Magnet Materials of Science Magnet Electrical Engineering Magnet Multimedia Communications

Comments: The Academy is in its 11th year of operation. The school's courses are designed to challenge students with rigorous curricula, integrated technologies, and extensive problem-solving strategies. Offering unique courses in math, science, technology, computer science, and English, the Academy gives students the latitude to pursue a broad spectrum of specialty areas while meeting the challenges of a highly academic course load. The average SAT I scores for Academy students are: 624 Verbal and 646 Math.

PROFILE

NORTH CAROLINA SCHOOL OF SCIENCE AND MATHEMATICS

Name of school:	The North Carolina School of Science and Mathematics (NCSSM)
Address:	1219 Broad Street, Durham, NC 27715
Telephone:	919.416.2600
URL:	www.ncssm.edu
Contact:	Craig Rowe, Director of Communications, 919.416.2872, rowec@ncssm.edu
Type of school:	Residential, public high school, science and math focus (First of its type in the US)
Day or residential:	Residential
No. of students:	620
Years of education provided:	2 (grades 11 & 12)
Admissions procedures/ description of the student body:	School is open to only NC students and represents all congressional districts and 90 of 100 counties. Students apply during fall of sophomore year and must have taken the SAT. Parents must be legal residents of NC. Applicants must demonstrate propensity towards science and math through previous academic and extracurricular involvement, must have superior academic record in all areas of study and should have demonstrated leadership capability. Students must submit four evaluation forms, a letter of recommendation, and a transcript. They also must attend Discovery Day and Welcome Day during admissions process. Racial/ethnic and gender composition of the student body (2003-2004): Caucasian – 63.3%; Asian – 19.1%; Black – 13.3%; Hispanic – 2.7%; and Native American – 1.6%. Males – 50% and females – 50%.
Persistence rate:	The school's overall graduation rate since 2000 is 87%.

Special services: Supervised study programs (study hall) for all juniors during first trimester, afterwards for any student with one (1) "C" grade in any class. Faculty has office hours and provides tutorial sessions regularly. Students can also be approved for an underload (less than normal number of courses per trimester). Graduation requirements still apply. Special accommodations for students with difficulty outside of diagnosed learning disability are treated on a case-by-case basis.

Programs/ Strategies: The whole school is designed to establish a culture of learning. There is a rigorous selection process to choose students who will be successful in such a learning environment.

Pathways: Students are required to complete 5 trimester units of mathematics; 4 of English, biology, chemistry, physics and foreign language; 1 of physical activity and wellness; 3 of academic electives; 2 of Mini-Term; and 2 of Student Life Curriculum. They are also required to complete 60 hours of unpaid community service in their hometown and three hours per week of work service for the school.

Comments: This school is considered a premier member of NCSSSMST (National Consortium of Specialized Secondary Schools for Science, Math and Technology). Thirteen like high schools in US are modeled directly after NCSSM. NCSSM is considered one of the nation's top Ivy League feeder schools, even with the state-backed program providing tuition grants for all graduates attending a UNC-system college or university.

For the last 3 years, NCSSM has had the most number of Siemens-Westinghouse Competition semi-finalists from any one high school in the country. Two (teams) have been named winners in last 4 years.