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Profiles of State-Supported Residential Math and Science Schools

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Concerned educators are alarmed with the shrinking number of American science and engineering students and the parallel rise in their foreign counterparts. Without a larger domestic pool of scientists and engineers, there is concern that America may lose its competitive position in the world. Articles decrying the erosion of America's technological dominance frequently appear in influential newsmagazines and commentaries (Dye, 2004).

A number of measures have been suggested to address this decline, including acceleration (e.g., Colangelo, Assouline, & Gross, 2004). Early college entrance programs represent one longstanding accelerative model. Sethna, Wickstrom, Boothe, and Stanley (2001) noted that more than a century ago, some colleges allowed early admission provided certain examinations were passed. In the 1950s, a Ford Foundation grant supported the early admission of students to 10 universities (Sethna et al., 2001). Concerns that social or emotional disjunction would necessarily accompany acceleration have been largely dispelled. A review of research on early college entrants, for example, showed impressive academic achievement by well-adjusted accelerants (Olszewski-Kubilius, 2002).

Summary

Unless we sharply increase the training of homegrown math and science talents, we may suffer negative economic and technological consequences. One means of addressing this challenge has been through specialty schools devoted to science, technology, engineering, and mathematics (STEM) training. In 1980, the North Carolina School of Science and Mathematics pioneered a successful program for high-achieving youth: the state-supported residential math and science school. Almost 30 years later, 15 similar schools have been created, including residential schools in Maine, Illinois, Louisiana, Mississippi, Indiana, Kentucky, Tennessee, South Carolina, Alabama, and Arkansas; and early college entrance academies in Texas, Missouri, and Georgia. Students are appropriately supervised and actively participate in athletics and a wide range of clubs and organizations. Admission is necessarily selective as students negotiate a challenging curriculum of advanced biology, chemistry, physics, and mathematics, as well as humanities and electives. Laboratory mentors guide students in research, results of which may be published or presented at colloquia. A select few projects are entered into the Intel Science Talent Search, Siemens-Westinghouse Science and Technology competitions, or other competitive programs. Performances are encouraging. Students pursue learning at an accelerated pace, saving considerable time and expenses. Graduates enroll in college, many at selective institutions, ensuring a boost in the number and quality of domestic mathematicians, scientists, and engineers.

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Math and science high schools are an accelerative alternative to early college programs. Brooklyn Technical High School, Bronx High School of Science, and Stuyvesant High School are well-known specialized schools established more than 70 years ago in New York. Attracting intellectually gifted students, these math and science schools prepare youth for careers in the science, technology, engineering, and mathematics (STEM) fields. Today, more than 100 schools are listed as members of the National Consortium of Specialized Secondary Schools of Mathematics, Science, and Technology (NCSSSMST). Some advocate expanding the number of specialty math and science high schools to boost the supply of American STEM talent (Atkinson, Hugo, Lundgren, Shapiro, & Thomas, 2007).

In 1980, the North Carolina School of Science and Mathematics introduced what has become a template for state-sponsored residential math and science schools (SRMSs). Within 20 years, almost a dozen similar schools had emerged across the country (Stephens, 1999). In just the past 7 years, three additional schools have opened, another is in the final planning stages, and still others are under consideration, all under the NCSSSMST umbrella.

The 100 or so NCSSSMST schools are roughly 80% nonresidential, 18% residential, and 2% both residential and nonresidential (Atkinson et al., 2007). The present review addresses the residential STEM-focused schools. Listed in Table 1, these 16 specialized schools accept sophomore, junior, and senior high school students and immerse them in demanding college-level instruction.

Authors have described only a few of the SRMS schools, including the North Carolina School (Eilber, 1987), the Texas Academy (Stanley, 1991), Advanced Academy of Georgia (Sethna et al., 2001), and Indiana Academy (Cross, Margison, & Williams, 2003). Stephens (1999) presented brief sketches of the 12 SRMS schools then in existence, and Boothe, Sethna, Stanley, and Colgate (1999) compared 3 of the SRMS schools with 5 other nonmath and nonscience residential schools. The 3 SRMS schools were the Advanced Academy, Texas

Table 1

State Residential Math and Science School With Enrollment Highlights

School (Founded)	Entering Class	All Classes	Web Site
North Carolina School of Science and Mathematics (1980)	341	615	http://www.ncssm.edu
Louisiana School for Math, Science, and the Arts (1982)	174	304	http://www.lsmsa.edu
Illinois Mathematics and Science Academy (1986)	250	650	http://www.imsa.edu
Texas Academy of Mathematics and Science (1987)	200	378	http://www.tams.unt.edu
Mississippi School for Mathematics and Science (1987)	140	200	http://www.msms.k12.ms.us
South Carolina Governor's School for Science and Mathematics (1988)	67	128	http://www.scgssm.org
Indiana Academy for Science, Mathematics, and Humanities (1988)	156	300	http://www.bsu.edu/academy
Alabama School of Mathematics and Science (1989)	150	300	http://www.asms.net
Oklahoma School of Science and Mathematics (1990)	70	144	http://www.ossm.edu
Arkansas School for Mathematics, Science, and the Arts (1993)	150	300	http://asmsa.net
Maine School of Science and Mathematics (1993)	57	119	http://www.mssm.org
Advanced Academy of Georgia (1995)	30	67	http://www.advancedacademy.org
Georgia Academy of Aviation, Mathematics, Engineering, and Science (1997)	52	91	http://www.mgc.edu/academic/scimathenga/games
Missouri Academy of Science, Mathematics, and Computing (2000)	88	128	http://www.nwmissouri.edu/masmc
Carol Martin Gatton Academy of Mathematics and Science in Kentucky (2007)	120	120	http://www.wku.edu/academy
Tennessee Governor's Academy of Science and Mathematics (2007)	24	24	http://www.tga.tennessee.edu

Academy, and Georgia Academy of Aviation, Mathematics, Engineering, and Science (GAAMES); and the 5 nonmath and nonscience schools were the Texas Academy of Leadership in the Humanities, Simon's Rock College, Mary Baldwin College's Program for the Exceptionally Gifted, the Clarkson School, and the Resident Honors Program of the University of Southern California. Tuition, admission requirements, curricula, and residential components were compared for the benefit of educators, parents, and high-achieving students (Boothe et al., 1999).

Cross and Miller (2007) were the first to closely inspect 15 SRMS schools, comparing and contrasting them with 5 specialized arts high schools. Building on that examination, the current précis provides additional details about academic programs and student life at the SRMS schools, now numbering 16. The operations of these specialized schools bear further inspection to satisfy national and even international interest shown by emerging schools. Increasingly, fact-finding delegations arrive on the campuses to observe operations and practices.

Methodology

Information presented in tabular form and throughout the text came from four principal sources: school brochures, Web sites, student handbooks, and from SRMS admissions officers. Annual reports, current handbooks, and promotional literature provided curricular requirements, residence hall policies, athletic offerings, and lists of school clubs and organizations. Student course catalogs were the basis for tables presenting class options and electives. Admissions representatives attending annual conferences through summer 2008 provided enrollment figures and corrected outdated or unclear policies, practices, and procedures.

Many of the specialized schools are known locally by acronyms or other shorthand designations. For clarity, the present references will use state names rather than the more common, but less widely known, designations. Hence, the convention will

be Mississippi School and Maine School, for instance, rather than MSMS and MSSM; and similarly, Texas Academy students rather than TAMSters. An exception will be made to distinguish the two Georgia schools, Advanced Academy of Georgia and GAAMES.

Findings

High Achievers

The 16 SRMS schools serve talented high-school-aged students pursuing STEM careers; there is comparatively little cost, courtesy of state appropriations. Students live among their academic and chronological peers and pursue similar goals while participating in athletics, recreation, and an array of clubs and organizations. Four of the STEM-focused schools serve students in grades 10, 11, and 12, while the remaining serve youth in grades 11 and 12. Enrollments range from 67 students at the Advanced Academy of Georgia to 650 students at the Illinois Academy.

The SRMS schools either have their own campus or are located on university campuses, with state appropriations considerably smaller for the university-based schools. For example, in fiscal year 2007, the Texas Academy appropriation was $1.4 million compared with $17.7 million for the Illinois Academy (Illinois Board of Higher Education, 2006, p. 93). Admission is restricted to state residents at all schools except Maine, Missouri, and the Advanced Academy of Georgia, which require higher fees from nonresidents.

The 16 SRMS schools are categorized as either early college entrance academies or as independent residential high schools. The 5 early college entrance schools are headquartered on university campuses. The 11 independent schools are a mix of university-based and autonomous schools, but all independent schools employ their own faculty and set their own curricula.

Early College Entrance Academies

Stanley (1991) touted the Texas Academy university-based model as highly cost-effective because university professors and facilities are used, eliminating the need to hire, supervise, or accredit teachers or to equip expensive laboratories. Nine of the 16 SRMS schools are located on university campuses. University faculties instruct students at 5 of these schools right along with traditional college students (see Table 2).

The early college entrance academies are the *Texas Academy of Mathematics and Science* at the University of North Texas in Denton; the *Advanced Academy of Georgia*, part of the Honors College of the University of West Georgia in Carrollton; the *Georgia Academy of Aviation, Mathematics, Engineering, and Science* at Middle Georgia College in Cochran; the *Missouri Academy of Science, Mathematics, and Computing* at Northwest Missouri State University in Marysville; and the *Carol Martin Gatton Academy of Mathematics and Science* at Western Kentucky University in Bowling Green.

The early college entrance designation is nuanced. Texas Academy students, for example, are in fact enrolled in college, yet unlike university classmates, are barred from fraternities and sororities, subject to nightly curfews, ineligible for marching band or intercollegiate athletics, and forbidden from establishments serving alcohol. Two years of study culminate in what the state honors as an advanced high school diploma, signifying 60 or more college credits earned. Students at both the Texas and Kentucky academies earn dual high school and university credit. Students at Missouri, the Advanced Academy, and the Georgia Academy earn high school credit and associate's degrees. Depending on credit transfer policies of admitting institutions, academy graduates may be admitted to universities as juniors.

Independent Schools

The independent SRMS schools are given in Table 3. The first 4 are university-based, allowing students access to certain

Table 2

Early College Entrance Academies With Selected Statistics

Academy	Campus (Enrollment)	Academy Enrollment	% M/F	Fees	Room & Board	GPA		Quiet/ Study (S) Hours	Curfew	
						To Enter	To Graduate		Week	Weekend
Texas	University of North Texas (34,795)	378	55/45	$1,300	$5,862	3.5	3.0	8-9 p.m.	11 p.m.	1 a.m.
Advanced Academy	University of West Georgia (10,208)	300	61/39	$1,280 in state $5,121 out	$2,581	3.5	3.0	Unlisted	11 p.m.	12 a.m.
GAAMES	Middle Georgia College (3,199)	91	57/43	0	$4,450	3.5	2.75	9-11 p.m. (S)	11 p.m.	12 a.m.
Missouri	Northwest Missouri State University (6,422)	128	50/50	0	$7,095	3.5	2.75	8 p.m.- 8:30 a.m.	10:30 p.m.	11:30 p.m.
Kentucky	Western Kentucky University (19,215)	120	50/50	0	0	3.0	2.5 (3.5 Honors)	7-9 p.m. (S)	10:30 p.m.	11:30 p.m.

college classes, facilities, and resources, while remaining independent of university curricula. Housing and, with rare exceptions, classes for these 4 independent schools are in their own facilities with their own faculty. The remaining 7 independent schools are autonomous and have their own campuses.

The university-based independent schools include the *Louisiana School for Math, Science, and the Arts* at Northwestern State University in Natchitoches; the *Mississippi School for Mathematics and Science* at Mississippi University for Women in Columbus; the *Indiana Academy for Science, Mathematics, and Humanities* at Ball State University in Muncie; and the *Tennessee Governor's Academy of Science and Mathematics* at the University of Tennessee at Knoxville.

Students at the Louisiana School use college textbooks. Certain courses at the Indiana Academy qualify for dual credit with Ball State University. The curriculum at the Mississippi School includes dual credit English and math courses accepted by Mississippi University for Women and physics classes accepted by Mississippi State University. At the Tennessee Governor's Academy, math and science students reside in cottages at the Tennessee School for the Deaf.

The remaining 7 schools have their own campuses and hire their own faculty:

- The *North Carolina School of Science and Mathematics*, located in Durham and part of the University of North Carolina System, enrolls some 615 juniors and seniors.
- The *Illinois Mathematics and Science Academy* near Chicago in Aurora serves approximately 650 students in grades 10 through 12.
- The *Arkansas School for Mathematics, Science, and the Arts* in Hot Springs is governed by the University of Arkansas system and enrolls about 300 juniors and seniors.
- The *South Carolina Governor's School for Science and Mathematics* in Hartsville enrolls about 125 juniors and seniors. Graduates receive both State of South Carolina and Governor's School diplomas.

Table 3

Independent Residential Math and Science High Schools

	School	Campus	11, 12	10, 11, 12	% M/F	Tuition	Room and Board	Courtesy Study Hrs/Quiet Hrs	Curfew Week/ Weekend	Lights Out Week/Weekend
University-Based	Louisiana	Northwestern State University	—	X	55/45	0	$1,125	—/9 p.m.–9 a.m.	10 p.m./12 a.m.	12 a.m.
	Mississippi	Mississippi University for Women	X	—	48/52	0	0	8–10 p.m./—	10:30 p.m./12 a.m.	12 a.m./2 a.m.
	Indiana	Ball State University	X	—	37/63	0	$1,600 fees	—/9 p.m.–12 a.m.	12 a.m./ 12:30 a.m.	1 a.m.
	Tennessee	University of Tennessee	X	—	50/50	0	0	—/—	—	—
	North Carolina	Durham	X	—	50/50	0	0	8:30–10 p.m./8:30 p.m.–8 a.m.	12 a.m.	1 a.m.
Autonomous	Illinois	Aurora	—	X	50/50	0	0	7–9 p.m./—	11:30 p.m./1 a.m.	—
	South Carolina	Hartsville	X	—	50/50	$1,200 fees	0	8–10 p.m./—	10:30 p.m./12 a.m.	12 a.m.
	Alabama	Mobile	—	X	48/52	0	0	8–10 p.m./7 p.m.–7 a.m.	11:45 p.m./ 12 a.m.	1 a.m.
	Oklahoma	Oklahoma City	X	—	50/50	0	0	8–10 p.m./—	8 p.m./10:30 p.m.	11 p.m.
	Arkansas	Hot Springs	X	—	49/51	0	0	7–9 p.m./—	11 p.m./1 a.m.	12 a.m./1 a.m.
	Maine	Limestone	—	X	50/50	0	$6,400	7–9 p.m./—	10 p.m./12 a.m.	1 a.m.

- The *Oklahoma School of Science and Mathematics* in Oklahoma City serves about 150 juniors and seniors selected from each of the state's 77 counties.
- The *Alabama School of Mathematics and Science* in Mobile serves 300 sophomores, juniors, and seniors.
- The *Maine School of Science and Mathematics* in Limestone enrolls about 120 sophomores, juniors, and seniors.

Students pay no tuition at the SRMS schools. Nine schools grant room and board waivers. Financial aid is available at the 7 schools that charge housing fees. Funding for these public institutions is tied to the economic health of the state, directly impacting enrollment and services. As an illustration, a $10.5 billion state deficit in 2003 compelled the Texas Legislature to slash the Texas Academy allocation by 12.5%. In response, the Academy administration opted not to cut class size, or reduce staff and services, but reluctantly charged each new student $1,300 (Sinclair, 2003). In the aftermath, more than 40 of 200 new students surrendered their seats (< 10 normally); all were replaced by waiting list candidates. Financial aid applications rose; however, diversity and credentials changed little, demonstrated by the fact that the strong alternates only brought the class SAT average down from 1301 to 1287.

Development and fundraising agencies can assist programs imperiled by legislative cuts. A prime example is the nearly $1.3 million awarded to the Illinois Academy in 2003 by the Illinois Mathematics and Science Academy Fund for the Advancement of Education (IMSA Fund for Advancement of Education, 2003). Similarly, North Carolina's Development Department and the Louisiana School for Math, Science, and the Arts Foundation support their respective schools, the latter providing $10,000 in 2005 to Louisiana School families impacted by Hurricanes Katrina and Rita (Widhalm, 2008).

Admissions

Field visits and direct mail appeals alert young talents to the SRMS schools. Applications require outstanding records, extra-

Table 4

Application Requirements of State Residential Math and Science Schools

		References				Interview		Standardized Test				
	Transcripts, Essays, Math, and Science References	English Teacher	Other Teacher	Administrator	Other	Applicant	Parent	SAT	ACT	PSAT	PLAN	Math Test
Alabama	X				X	X		X	X		X	
Arkansas	X		X			X		X	X	X	X	
GAAMES	X					X	X	X	X			
Advanced Academy	X		X			X	X	X	X			
Louisiana	X	X	X			X		X	X			
Indiana	X	X		X				X				
Oklahoma	X	X		X		X			X			
Maine	X	X			X	X		X		X		
Kentucky	X	X			X	X		X	X			
Tennessee	X	X		X		X						
Texas	X	X		X		X		X				X
North Carolina	X	X		X				X				X
Illinois	X	X		X				X				
Mississippi	X	X		X		X			X			
South Carolina	X	X		X				X	X	X	X	
Missouri	X	X						X	X		X	

curricular activities, teacher evaluations, and parental statements (see Table 4).

The schools seek competitive transcripts (predominantly *A*s), and endorsements from math and science teachers. Most (75%) also require an English teacher evaluation. Texas and North Carolina administer diagnostic math tests to finalists. Eleven of the 16 schools conduct on-campus applicant interviews; the 2 Georgia schools also conduct parental interviews in lieu of parental statements accepted elsewhere. The value of admissions

interviews, however, has been disputed. Feldhusen and Jarwan (1995) found SRMS interviews to be poor predictors of academic performance when compared to high school grades and SAT scores, with the math section (SAT-M) an especially powerful predictor for minorities.

Table 4 shows that 7 schools accept either the SAT or ACT alone, while the rest will accept combinations of PSAT, PLAN, ACT, or SAT. Four of the SRMS schools publish minimum score requirements on Web pages:

- SAT–Math
  - 560 (Missouri and GAAMES), 530 (Advanced Academy of Georgia), 520 (Kentucky)
- SAT–Verbal
  - 580 (Advanced Academy of Georgia), 550 (GAAMES)
- ACT–Math
  - 24 (Missouri and GAAMES), 22 (Advanced Academy of Georgia)
- ACT-Verbal
  - 25 (Advanced Academy of Georgia), 23 (GAAMES)

The remaining schools do not specify cutoff scores. In 1996, the Texas Academy set SAT minima of 600-M with 1100 M+V, but struck the requirement in 2001 when Texas House Bill 1641 disallowed the designation of a threshold score as a prerequisite for graduate or professional school admission. Although wholly exempt from the provision, the Academy complied with the spirit of the ruling, replacing the 600 cutoff with the requirement that sophomore scores compare favorably with college-bound senior scores. In practice, few sub-600 applicants have been admitted; the subsequent 5-year average was 667, compared with the prior average of 669.

Aside from academic talent, admission committees assess motivation, career interest, extracurricular involvement, and other characteristics suggesting a good match. Applicants must submit essays or written statements explaining their reasons for applying. Common themes repeatedly appear, such as boredom

with high school, desire for challenge, or visions of future accomplishment. Two examples:

> I definitely look forward to the pressure and challenge of the Indiana Academy. I am bored with my classes, because they don't challenge me enough.
>
> —Indiana Academy applicant

> Ten years from now I believe I will be either working on my Master's or Ph.D. in biophysics or be attending medical school. I hope to find a cure for some genetic diseases and disorders.
>
> —Oklahoma School applicant

The search for prospective students begins as early as seventh grade. Middle school prospects are sometimes identified at math camps operated by several SRMS schools, such as the Young Scholars Institute (Advanced Academy of Georgia), Saturday Youth Enrichment Program (Indiana Academy), and Summer Math Institute (Texas Academy). The North Carolina School hosts the state math and science fair competitions, presenting another opportune occasion to scout prospects.

Not every talented sophomore is persuaded to apply. SRMS schools may be inappropriate for those unwilling to relocate, attend boarding school, or part with friends (Jones, Fleming, Henderson, & Henderson, 2002). But admission officers also complain of educators who, fearing the exodus of premier students, will deny access to their classes (group interview, July 21, 2007).

In *A Nation Deceived: How Schools Hold Back America's Brightest Students,* Colangelo et al. (2004) suggested 12 reasons acceleration isn't more widely accepted by educators, from unfamiliarity with acceleration research to basic philosophical differences. In 1996, the Association of Consortium Admissions Representatives (ACAR) was founded at the Indiana Academy as a forum to address such issues. ACAR representatives meet annually to share recruiting, enrollment, and programming data

hoping to better communicate the value of acceleration, and to benefit enrollment management at all of the residential schools.

Diversity

Schools admit a cross section of the state's top performers, shown by the ethnic profiles of entering classes (admits) in Table 5. For context and comparisons, the corresponding ethnic profiles of their respective states also are included. Uniquely, North Carolina is legislatively mandated to admit equal percentages of students from each of the state's 13 congressional districts. Thus, applicants compete for admission only against others from the same district (L. Mason, personal communication, July 15, 2008).

In the absence of legislation, inclusion is mediated by cultural and economic considerations. Asians are disproportionately represented in all of the residential schools (see Table 5). This is not surprising given that a greater percentage of Asians take advanced math and science courses as compared to other ethnic groups (Camara & Schmidt, 1999; Planty, Provasnik, & Daniel, 2007).

Moreover, SAT scores rise with level of parental education and family income (College Board, 2007), so it was not surprising when a 2004 survey revealed 30% of Texas Academy parents had earned graduate degrees: 20% had one graduate degree and 10% had two or more graduate degrees (Jones, 2004a). Even so, Texas Academy students represent the state's entire economic spectrum, and 20% receive financial aid. Corresponding figures at other schools are unknown.

Gender Equity

Benbow and Arjmand (1990) found gifted males pursue scientific careers more frequently than gifted females. This reinforces the need for recruiters to prioritize the identification of bright females by consulting talent search lists, through field visits, and via nominations from students, teachers, counselors, professional women's groups, and alumni. Except at Indiana where

Table 5

Enrollment by Racial and Ethnic Group of State Residential Math and Science Schools

	Caucasian		African American		Hispanic		Asian		Native American	
School	Admits	State	Admits	State	Admits	State	Admits	State	Admits	State
North Carolina	65%	74.1%	12%	21.9%	3%	5.6%	18%	1.7%	1%	1.3%
Louisiana	78	64.2	10	32.9	2	2.6	7	1.4	—	0.6
Illinois	44.7	79.5	9.7	15.2	4.6	13.6	32.7	4.0	—	0.3
Texas	37.9	83.6	8.3	11.6	6.8	34.2	46.0	3.0	1.0	0.7
Mississippi	57	61.2	23	36.9	1	1.5	18	0.8	—	0.4
South Carolina	78	67.7	8	30	—	2.8	12	1.1	—	0.4
Indiana	67.8	88.9	5.3	8.6	2.6	3.9	7.2	1.2	—	0.3
Alabama	61.7	71.3	25.9	26.4	1.8	2	6.9	0.8	0.7	0.5
Oklahoma	67.9	78.4	2.6	7.9	2.6	5.7	15.4	1.6	11.5	8
Arkansas	82.4	81	5	16.2	3.1	3.7	8.2	0.9	1.3	0.7
Maine	90	97.1	5	0.6	—	0.8	5	0.8	—	0.6
Advanced Academy	73.6	67.5	7.5	28.7	5.7	6.2	13.2	2.4	—	0.3
GAAMES	61	67.5	21	28.7	2	6.2	7	2.4	—	0.3
Missouri	90	85.3	4.4	11.6	—	2.3	3.3	1.3	2.2	0.5
Kentucky	TBA	90.3	TBA	7.6	TBA	1.7	TBA	0.9	TBA	0.2
Tennessee	TBA	80.8	TBA	16.7	TBA	2.5	TBA	1.2	TBA	0.3

Table 6

Required Courses at 16 State Residential Math and Science Schools

	Number of Schools Requiring These Courses
Mathematics	16
Biology	16
Chemistry	16
Physics	16
Social Studies	14
English	16
Foreign Language	12
Arts, Music, Drama	10
Health, Physical Education	9
Business, Technology	10

females outnumber males (63% vs. 37%), most of the specialized schools have nearly equal numbers of males and females (see Tables 2 and 3).

Curriculum

Early entrance SRMS students share classrooms with traditional, usually older college students and take lectures from Ph.D. university faculty. In the residential high schools, the proportions of instructors holding master's, doctoral, or other terminal degrees varies (e.g., 33% possess Ph.D.s at Mississippi; 67% possess Ph.D.s or MFAs at Louisiana).

The core curricula at the SRMS schools show few differences, as all require advanced English, mathematics, chemistry, physics, biology, and social studies, with differing credit hour combinations needed for completion (see Table 6). Ten of the 16 schools also have business and technology requirements. For example, the Missouri Academy requires computer programming.

The Louisiana and Arkansas schools have arts components, requirements, which can be satisfied through drama, band, cho-

ral music, or other options. Louisiana students may choose to concentrate on either math and science or the arts. Arts applicants must submit photography or art portfolios, or they may submit an audition in voice, dance, piano, or theatre.

Beyond the challenging core, SRMS students also may choose electives that expose them to rigorous study in the sciences, social sciences, and the arts. As examples, North Carolina students have taken astrophysics as well as galaxies and cosmology. Illinois students have opted for organic chemistry or a class on microbes and disease; and at Texas, multivariable calculus and real analysis are among the many options. Humanities, too, are popular: British, American, or world literature (GAAMES); women of the South and civil rights (Alabama); and psychology, music, and a variety of other options (elsewhere). Texas and Missouri students may take one elective (3.0–3.49 GPA required) or two electives (3.5–4.0 GPA) each semester from any course offered by their respective universities.

Schools not requiring health, wellness, or physical education as core subjects (Alabama, Missouri, Kentucky, Tennessee, Maine, Mississippi, and Texas) offer those as electives. The same is true for schools not requiring arts or music (GAAMES, Missouri, Kentucky, Tennessee, Texas, and North Carolina).

SRMS schools do not rank students, finding little point in further calibrating top performers. Collaborative learning is therefore encouraged, even as students are expected to maintain certain grades. At both GAAMES and the Missouri Academy, a 2.75 GPA is required to remain in good standing, while the Texas Academy requires a 3.0. Arkansas students simply have to pass all classes ($\geq$ 60%) to earn diplomas. Several schools—Illinois and Mississippi among them—do not compute grade-point averages, which stymie attempts to compare and contrast class ranks.

Research

Almost all of the SRMS schools encourage scientific research. Arkansas students must take a course in research methods. Every

South Carolina student completes the Summer Program for Research Interns, working with scientists in labs across the state. Mentors help the students analyze findings and prepare papers for colloquia presentations.

About one third of Oklahoma's seniors conduct mentor-assisted research or product development each year. Texas Academy Research Scholarships have been competitively awarded to roughly 70 rising seniors annually for mentor-guided summer research at the University of North Texas (UNT), at statewide health science centers, at the Johnson Space Center (NASA) in Houston, and overseas. Illinois' Student Inquiry and Research Program pairs students with scientists to conduct and present research for publications and conferences (St. Pierre, 2008). Louisiana students who pursue well-conceived research projects may graduate *With Distinction*.

SRMS students have placed in Intel Science Talent Search and other prestigious competitions. Unique access to data, made available by their mentor, led three North Carolina School students to discover a neutron star, or pulsar, and place first in the 2000 Siemens-Westinghouse Science and Technology Competition (Wanjek, 2000). Supported by an Academy research scholarship, a Texas Academy senior was the $100,000 first-place winner in the 2008 Siemens-Westinghouse competition for engineering a polymer coating that releases bacteria-killing ions (University of North Texas News Service, 2008).

Several schools have departments devoted to helping students prepare research projects for national scholarships and competitions. The Oklahoma School offers a directed study course to prepare students for the U.S. National Chemistry Olympiad examinations. Oklahoma participants have won gold and other medals in national and international Olympiads (e.g., 26th International Physics Olympiad). UNT's Office for Nationally Competitive Scholarships advises Texas Academy students. At UNT, 31 students have been named Goldwater Scholars since 1996; MIT has had 41 Goldwater Scholars during the same period (University of North Texas News Service, 2006).

Student Life

SRMS students engage in popular adolescent pursuits, such as dances, movies, computer games, and proms. Student life departments support typical high school recreational activities and organizations. With more than 600 students each, Illinois (77 organizations) and North Carolina (76) list the largest number of clubs and organizations on their Web pages and publications. A South Carolina bulletin lists 35 clubs and societies, drawing near-universal student participation (State of South Carolina, 2007). Table 7 contrasts common and unique clubs at SRMS schools.

Community service is greatly encouraged if not required at all of the SRMS schools. At North Carolina, community service has been a graduation requirement since 1982. At Kentucky, sample initiatives include Habitat for Humanity or Big Brothers and Big Sisters projects. Louisiana assignments include maintaining grounds and buildings as well as cafeteria service, to cite a few.

Student behavior is governed by residence hall policies set forth in handbooks. Curfews, lights out, and study hours are given in Tables 2 and 3. The male-female visitation privilege is restricted to permissible hours and subject to rules of verifiable conduct. The consequences for violating rules also are stipulated in handbooks, with penalties assessed as demerits, suspension of privileges, or other sanctions. Accumulated violations can subject offenders to behavior contracts or in extreme cases, dismissal. The penalty for alcohol possession ranges from first-offense probation at North Carolina to automatic dismissal at the Advanced Academy of Georgia and at Texas, where zero tolerance prevails.

Students vacate the residential schools on predesignated weekends. Known variously as Long Weekends (South Carolina), Closed Weekends (Texas), Extended Weekends (Indiana and Louisiana), and by other appellations, such breaks occur every 4 or 5 weeks and allow students to reconnect with families while permitting residence life staff a short respite.

Table 7

Clubs and Organization at State Residential Math and Science Schools

Common Among Math and Science Schools	Rare or Unique	
	North Carolina	*Louisiana*
Key Club	The Society for the Easily Amused	Earthcare
Math Club	Rock Climbing	Catholic Faith
Drama	Asian Cultures Club	Fantasy and Science Fiction
Habitat for Humanity	Students for a Free Tibet	Pre-Law Club
Chess		
Speech and Debate	*Texas*	*South Carolina*
JETS	FACES (cultural diversity)	Archery Club
Yearbook	Masters of Entertainment	Break Dancing Club
Robotics	Research Club	Mixed Martial Arts
Model United Nations	Medical Society	Cheese Society
Anime		Yarn Society
Bible Study	*Indiana*	
Student Ambassadors	Chinese Club	*Arkansas*
Orchestra	Indian Club	Youth Extinguishing Smoking
Prom	German Club	Ping Pong Club
Mu Alpha Theta	Adventure Club	Poker Club
		Pause for Paws
	Illinois	
	Discussion Classics	*Maine*
	Future Problem Solvers	A Capella
	Madrigals (performance)	Cooking Club
	Hatikvah	Jazz Band

Athletics

Athletic programs flourish on the SRMS campuses. Participation in National Collegiate Athletic Association sports, however, is denied to early entrance students; a high school diploma is required to participate in NCAA athletics. Instead, active intramural leagues provide activities for academy youth,

with such common offerings as flag football, Ultimate Frisbee, basketball, soccer, softball, and volleyball.

In general, a wider selection of sports is offered at the residential high schools (see Table 8). Mississippi offers seven sports including Judo, while archery and badminton can be found at Alabama. North Carolina students compete in the broadest range of athletics, including all of the major sports except football. Louisiana fields interscholastic sports teams that compete with local high schools. According to its 2007 Annual Report, 89% of South Carolina School students participate in its nine sports (State of South Carolina, 2007).

The majority of SRMS schools have gyms or recreation centers featuring game courts, exercise equipment, or swimming pools. Texas Academy students have free access to UNT's $25 million Student Recreation Center.

Counseling

Personal and academic counselors are essential even for youth with rare aptitudes. All the schools have resident advisors and hall personnel who address minor social or emotional issues. Master's and doctoral-level personal counselors handle more involved needs. Services are free by appointment or on a walk-in basis. The professional counseling staff at the University of Tennessee Counseling Center serves Tennessee Academy students. Other schools with doctoral-level counselors are Missouri, Texas, and Kentucky. Missouri employs a full-time mental health counselor with a doctorate in counselor education. At Texas, the full-time professionals are a licensed adolescent psychologist (Ph.D.) and her assistant, a doctoral student. At Kentucky, a licensed professional clinical counselor with a doctorate heads the counseling department.

Counseling is confidential and incident reports are private. However, according to the Illinois handbook, referrals may involve "homesickness, anxiety, depression, inability to concentrate, family crises, stress, relationship difficulties, low self-esteem, [and] self-destructive behaviors (drug and alcohol abuse,

Table 8

Most Popular Athletics at Math and Science Schools

	Basketball	Baseball	Track and Field	Soccer	Volleyball	Swimming	Cheerleading	Cross Country	Tennis	Golf	Wrestling	Football	Softball
North Carolina	X	X	X	X	X	X	X	X	X	X	X	—	—
Louisiana	X	—	—	—	X	—	X	—	—	—	—	X	—
Illinois	X	—	—	X	—	—	X	—	X	X	—	—	X
Mississippi	X	—	—	—	—	X	X	—	X	X	—	—	—
South Carolina	X	—	X	X	X	X	—	X	X	—	—	—	—
Maine	X	X	X	X	X	X	X	X	—	X	—	—	—
GAAMES	X	X	—	X	X	—	—	—	—	—	—	—	X
Advanced Academy	—	X	—	X	X	—	—	—	—	X	—	X	X

purging, bingeing, self-starvation, self-mutilation, abuse of laxatives)" (Illinois Math and Science Academy, 2009, p. 21).

College and career counselors provide guidance with study skills and time management, initiating contact, if necessary, to assist high performers who are not accustomed to seeking help. Even with available assistance, some students underperform, manage time poorly, or fail to adjust to academic or social life and may ultimately withdraw from the SRMS schools.

Attrition

Sethna et al. (2001) reported 4-year retention rates at the Advanced Academy of Georgia as ranging from 82.4% to 89.7%, suggesting attrition to be 10.3% to 17.6%. Beyond these, reliable attrition figures for the SRMS schools are not available.

Admission officers at five SRMS schools quoted their attrition rates, respectively, as 5%, 10%, 10–20%, 15%, and 20% (personal communications, December 2, 2007 through January 8, 2008). These unsupported data await substantiation, but until then, insight is gained with a comparison group for which figures are known. Garrison, Mikesell, and Matthews (2007) found academic attrition for medical school cohorts in 1987, 1992, and 1995 to be just 1.4%. However, this low figure encompasses students who took as long as 10 years to graduate.

More relevant were 4-year completion rates, which ranged from 80.6% to 82.2%. Hence, the corresponding incompletion rates—analogous to attrition were there strict time limits—were 17.8% to 19.4% (Garrison et al., 2007). These values approach the unverified percentages cited above for SRMS students. Like medical students, math and science students negotiate demanding coursework, but without the luxury of extended graduation plans (which would, of course, defeat acceleration).

Among other reasons, attrition may be attributable to behavior breaches or insufficient academic progress. Based on student handbooks, SRMS schools have similar behavioral expectations, with penalties for violations such as stealing, cheating, plagiarism, and drug and alcohol possession. Given

confidentiality policies, the prevalence of serious behavioral violations across schools is not easily determined. Academically, students remain in good standing by meeting minimum grade requirements (see Table 3).

Students who leave before graduating may return to their high schools. They will have forfeited their former class rank, but counselors generally credit them for work completed. Alternatively, released students may take correspondence courses or even accept admission to a 4-year university, depending on the credits they have already earned.

Outreach and Enrichment Programs

States invest heavily in SRMS schools, and outreach programs represent one example of the return on that investment. Through a number of creative initiatives, the schools export strategies learned in classes and laboratories to teachers and students in the wider community. Due to disparities in school budgets, university-based SRMS are much less likely than independent schools to have outreach programs; the parent university is likely to manage outreach. Independent SRMS schools actively share their STEM teaching and learning expertise through partnerships and professional development activities.

Five outreach examples arbitrarily selected from school sites are listed below:

- The Indiana Academy sponsors weekend classes for elementary and middle school accelerated learners, part of its Saturday Youth Programs. Sample enrichment classes cover Greek mythology, astronomy, zoology, and aquatic environments.
- Illinois' Problem-Based Learning Network, Virtual High School, and Early Involvement Program help economically disadvantaged students improve English, mathematics, and science skills.
- North Carolina's extensive External Programs are collaborative efforts to improve the quality of K–12 teaching, especially in rural and remote regions of the state. Video/

audio connections allow communication between multiple sites.

- Maine's Summer X program for fifth- through ninth-grade students interested in math, science, and technology features classes such as Robotics Challenge and Physics of Ballistics.
- South Carolina provides a week of residential programs for rising 8th- to 10th-grade summer students to study robotics, aquatic ecology, chemistry, math, Web page creation, and other topics. Gaining Early Awareness and Readiness for Undergraduate Programs helps low-income youth enhance academic skills and acquire information, financial assistance, and psychosocial support.

Discussion and Conclusions

Many SRMS graduates are admitted to selective colleges and universities and offered millions in scholarships (Kolloff, 1997). A Louisiana School publication lists $153 million in merit-based scholarships offered to its 3,875 graduates (Louisiana School for Math, Science, and the Arts, 2008). According to the Illinois Academy site, the five out-of-state universities that enroll the highest number of Illinois graduates are Washington University, MIT, Stanford, Harvard, and Rice. Indiana claims a 99% matriculation rate, with most graduates admitted to their first choice institution. Well over 80% of Texas Academy graduates pursue STEM careers, a figure which approaches 90% if careers in STEM education also are included (personal communication, May 2008).

Officials at emerging math and science schools are taking notice, as delegations tour SRMS schools to plumb the accumulated wisdom. Visitors learn the importance of tuition and room/board waivers that attract talented students who would be otherwise unable to afford advanced instruction. Visitors also discover that the residence life staff members who deal with students day to day are carefully selected and trained. Quality

academic and personal counseling are essential in facilitating the transition from high school. Further, the athletic programs enjoy widespread participation.

As for student selection, officers can begin identifying prospects as early as seventh grade. Recruiters may expect cooperation from some school officials but should not be surprised to encounter resistance. Admissions standards should remain high and academic and social support liberally available. As SRMS schools mature, summer programs can be launched to introduce potential students to expectations and responsibilities, thereby serving as a prospect pool.

Nevertheless, SRMS schools are not appropriate for all bright students and were not conceived as such. Some students are unprepared to relocate, attend boarding school, or assume new responsibilities. In a series of surveys, respondents who had declined to apply to Texas expressed concerns the school's atmosphere might be too pressured and its student body too narrowly focused. A handful of respondents had questioned parents who allow their children to leave early for college, affirming their own aversion to doing so (Jones, 2004b).

Stereotypes and preconceived notions aside, advanced schools are an innovative option. For thousands of well-screened ambitious students, the schools are a relief from traditional settings. They are liberating environments that allow students to learn at a pace suited to their talents and be surrounded by intellectual peers. The schools answer the call of a number of U.S. agencies to increase the number and quality of domestic engineers and scientists.

The following female Texas Academy graduate symbolically speaks for many whose careers were launched in STEM-focused residential schools: "I defended my PhD in Molecular Microbiology last fall and am now working as a Scientific Advisor at an intellectual property law firm in Boston. Who would believe that I could have done all this by age 25!" (M. B. Clarke, personal communication, April 5, 2006).

References

Atkinson, R. D., Hugo, J., Lundgren, D., Shapiro, M. J., & Thomas, J. (2007). *Addressing the STEM challenge by expanding specialty math and science high schools.* Retrieved from http://www.ncsssmst.org/CMFiles/Docs/STEM%20Final_03_20_07.pdf

Benbow, C. P., & Arjmand, O. (1990). Predictors of high academic achievement in mathematics and science by mathematically talented students: A longitudinal study. *Journal of Educational Psychology, 82,* 430–441.

Boothe, D., Sethna, B., Stanley, J., & Colgate, S. (1999). Special opportunities for exceptionally able high school students: A description of eight residential early-college-entrance programs. *Journal of Secondary Gifted Education, 10,* 195–202.

Camara, W. J., & Schmidt, A. E. (1999). *Group differences in standardized testing and social stratification* (College Board Report No. 99-5). New York: College Board.

Colangelo, N., Assouline, S. G., & Gross, M. U. M. (2004). *A nation deceived: How schools hold back America's brightest students* (Vol. 1). Iowa City: The University of Iowa, The Connie Belin & Jacqueline N. Blank International Center for Gifted Education and Talent Development.

College Board. (2007). *National report.* Retrieved January 12, 2008, from http://professionals.collegeboard.com/data-reports-research/sat/cb-seniors-2007

Cross, T. L., Margison, J., & Williams D. (2003). The Indiana Academy for Science, Mathematics, and Humanities. *Gifted Education Communicator, 34,* 44–46, 62–63.

Cross, T. L., & Miller, K. A. (2007). An overview of three models of publicly funded residential academies for gifted adolescents. In J. L. VanTassel-Baska (Ed.), *Serving gifted learners beyond the traditional classroom* (pp. 81–104). Waco, TX: Prufrock Press.

Dye, L. (2004, December 2). U.S. falling behind in science: Is the U.S. losing its edge? *ABC News* Retrieved from http://abcnews.go.com/Technology/DyeHard/story?id=276464&page=1

Eilber, C. R. (1987). The North Carolina School of Science and Mathematics. *Phi Delta Kappan, 68,* 773–777.

Feldhusen, J. F., & Jarwan, F. (1995). Predictors of academic success at state-supported residential schools for mathematics and science: A validity study. *Educational and Psychological Measurement, 55,* 505–512.

Garrison, G., Mikesell, C., & Matthews, D. (2007). Medical school graduation and attrition rates. *Analysis in Brief, 7*(2), 1–2.

Illinois Board of Higher Education. (2006). *Fiscal year 2007 appropriations for higher education: General assembly action.* Retrieved from http://www.ibhe.state.il.us/Board/agendas/2006/June/Item9.pdf

IMSA Fund for Advancement of Education. (2003). *2002–2003 report to our donors.* Retrieved from http://www.imsa.edu/giving/annualreports/imsa_fund_annual_report_fy03.pdf

Illinois Math and Science Academy. (2009). *School handbook.* Retrieved from http://www.imsa.edu/living/handbook/handbook0809.pdf

Jones, B. M. (2004a). [Parental educational attainment survey]. Unpublished raw data.

Jones, B. M. (2004b). [Texas academy surveys of non-applicants, 2002–04]. Unpublished raw data.

Jones, B. M., Fleming, D. L., Henderson, J., & Henderson, C. E. (2002). Common denominators: Assessing hesitancy to apply to a selective residential math and science academy. *Journal of Secondary Gifted Education, 13,* 164–172.

Kolloff, P. B. (1997). Special residential high schools. In N. Colangelo & G. A. Davis (Eds.), *Handbook of gifted education* (pp. 198–206). Needham Heights, MA: Allyn & Bacon.

Louisiana School for Math, Science, and the Arts. (2008). *2008–2009 College admission profile.* Retrieved from http://www.lsmsa.edu/files/LSMSA%20College%20Admission%20Profile__08-09.pdf

Olszewski-Kubilius, P. (2002). A summary of research regarding early entrance to college. *Roeper Review, 24,* 152–157.

Planty, M., Provasnik, S., & Daniel, B. (2007). *High school coursetaking: Findings from the condition of education 2007* (NCES 2007-065). Washington, DC: National Center for Education Statistics.

St. Pierre, J. (2008). *IMSA 360.* Retrieved from http://www.imsa.edu/about/publications/pdf/IMSA360.pdf

Sethna, B. N., Wickstrom, C. D., Boothe, D., & Stanley, J. C. (2001). The advanced academy of Georgia: Four years as a residential early-college-entrance program. *Journal of Secondary Gifted Education*, *13,* 11–22.

Sinclair, R. J. (2003). *Academy profile.* (Available from the Texas Academy for Math and Science, 1155 Union Circle # 305309, University of North Texas, Denton, TX 76203)

State of South Carolina. (2007). *South Carolina's Governor's School for Science and Mathematics: The state of South Carolina annual report*

card. Retrieved from http://www.scgssm.org/public/files/docs/GSSM_report_card_2007.pdf

Stanley, J. C. (1991). A better model for residential high schools for talented youth. *Phi Delta Kappan, 72,* 471–473.

Stephens, K. R. (1999). Residential math and science high schools: A closer look. *Journal of Secondary Gifted Education*, *10,* 85–92.

University of North Texas News Service. (2006, March 28). *UNT leads Texas universities in the number of Goldwater Scholars.* Retrieved from http://web3.unt.edu/news/story.cfm?story=9672

University of North Texas New Service. (2008, December 8). *TAMS student captures national Siemens title, $100,000 scholarship*. Retrieved from http://web3.unt.edu/news/print.cfm?story=11275

Wanjek, C. (2000, December 12). *High school kids discover neutron star, take top science prize.* Retrieved August 27, 2008, from http://universe.nasa.gov/press/2000/cw00_28.html

Widhalm, P. (2008). *From the LSMSA executive director.* Retrieved August 8, 2008, from http://www.lsmsa.edu/content.cfm?id=109

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