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Albuquerque Association for Gifted and Talented Students

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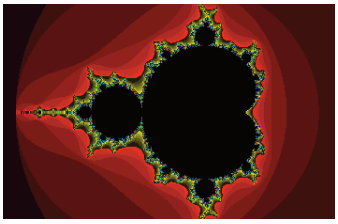
Fractals: Seeing Math in Everyday Life

by Lori MacKenzie

I've always liked math. The intricacies, the complexities of it. What it can prove and disprove. Many years ago I even flirted with the idea of becoming a theoretical physicist. I was, if you'll forgive the pun, sucked into the romance of wormholes, black holes, and deep, dark foreboding space. Chaos and entropy (so very much a part of my daily life now!) fascinated me. I found, however, my first major brick wall in that math wasn't, well, let's say, in my cosmic plan. As hard as I tried, and try I did, I just couldn't grasp it. I just didn't "get it." Finally, I gave up. I gave up on trying to do the math, but I never gave up on liking math.



Fractals were one of the mathematical wonders I remember reading about. Fractals—elegant and beautiful in design—are created using a relatively simple equation (Benoit Mandelbrot's standard fractal equation is z(n+1) = z(n)^2 + c) and can be found in nature (think romanesco cauliflower, ferns, and coastlines).

We are fortunate to have a fractal expert right here in Albuquerque. Jonathan Wolfe, Ph.D, president of Fractal Foundation, and a former Albuquerque Public School gifted student, brought his educationally packed 55-minute presentation on fractals to our April general membership meeting.

Sighting such objects as shells, blood vessels, snowflakes, lightning, and trees, Dr. Wolfe opened our minds to the virtual existence of fractals in our everyday lives. At one point, Dr. Wolfe took us zooming through a Mandelbrot fractal, which was a great example of the self-similar properties evident in fractals.

I'm not sure, though, who enjoyed the program more–the adults or the children. Thank you, Dr. Wolfe for a beautiful presentation.

A Bit About the Fractal Foundation

The Fractal Foundation uses the beauty of fractals to inspire interest in science, math, and art. Dr. Wolfe presents his show, *First Friday Fractals*, at the Museum of Natural History and Science Planetarium on the first Friday of each month. There are three showtimes to choose from: 6:00, 7:00, and 8:00 p.m. Since the shows often sell out, your best bet for securing tickets is to buy them online at www.fractalfoundation.org.

Several software programs which allow you to produce your own computer-generated fractals are also available on the Fractal Foundation web site—for free! Any K-12 student in New Mexico can enter their own creations in the "2008 Albuquerque Fractal Challenge." Check out the details on the web site.

President's Column: Last Lecture

Last fall, I came upon Randy Pausch's "Last Lecture" posted on the Internet. For those of you who haven't heard about Randy, he is a popular professor at Carnegie Mellon who has pancreatic cancer. He is dying.

If you haven't seen the lecture, go to:
http://video.google.com/videoplay?docid=-5700431505846055184

His book, *The Last Lecture*, was released this month. Although I haven't read it, yet, if it's anything like the lecture, I expect it to become a popular gift for high school graduates.

For more about the last lecture go to:
http://abcnews.go.com/gma/lastlecture

How does Randy Pausch's "Last Lecture" relate to the gifted community? Randy talks about brick walls. "The brick walls are not there to keep us out. The brick walls are there to give us a chance to show how badly we want something. Because the brick walls are there to stop the people who don't want it badly enough. They're there to stop the other people."
As advocates for gifted children, we often encounter brick walls. It can start with trying to get a child identified. Once identified, we encounter these walls in trying to get our children the challenges they need in school—getting those services into an Individualized Education Program (IEP), then convincing the school to honor the IEP. In the bigger picture, we encounter walls in trying to convince folks of the needs of gifted children in general, why these children need help, and trying to conquer the attitude that gifted services are elitist.

We must decide how badly we want the educational opportunities that gifted children need. Do we want it badly enough to meet with a teacher or principal or superintendent? Do we want it badly enough to write a letter, make a phone call, or contact the media? Do we want it badly enough to miss a day of work and find someone to care for our children so we can drive to Santa Fe at the last minute and lobby legislators? Or do we want to sit back and hope that others will be willing to beat against the wall until they break it down, find another way around it, or fail in the attempt?

In making our decisions, we must remember that gifted children deal with these brick walls every day—classes where they learn nothing, their concern over the enormity of the world's problems, the bully during passing period, in the classroom, or on the playground. Some students will deal with the brick walls alone. They will break them down, find a way around them, or give up and choose another path. They will study on their own, become the class clowns, organize students to help the underprivileged, demand more rigorous classes, or drop out of school. Some will have the support of parents or another interested adult to help them deal with the bully, the boredom, the world's problems. Some won't.

Brick walls are good—for us and our children. Without these walls, our children would not learn about struggle. Brick walls help us decide what is important. They make us think. They make us reach. They make us dream of something better.

Below is an excerpt from the National Mathematics Advisory Panel's "Foundations for Success," which addresses gifted students.

Teaching Mathematically Gifted Students

The Panel's review of the literature about what kind of mathematics instruction would be most effective for gifted students focused on the impact of programs involving acceleration, enrichment, and the use of homogeneous grouping. Although many syntheses and summaries of research in these areas have been conducted, our searches yielded surprisingly few studies that met the Panel's methodologically rigorous criteria for inclusion; thus for this section we relaxed these criteria to fulfill the charge of evaluating the "best available scientific evidence." The Panel could formulate its recommendations only on the basis of one randomized control trial study and seven quasi-experimental studies. These studies have limitations. For instance, motivation is a confounding variable, just as it is a selection criterion for being considered a candidate for acceleration.

The Panel's key findings are the following:

- The studies reviewed provided some support for the value of differentiating the mathematics curriculum for students with sufficient motivation, especially when acceleration is a component (i.e., pace and level of instruction are adjusted).
- A small number of studies indicated that individualized instruction, in which pace of learning is increased and often managed via computer instruction, produces gains in learning.
- Gifted students who are accelerated by other means not only gained time and reached educational milestones earlier (e.g., college entrance) but also appear to achieve at levels at least comparable to those of their equally able same-age peers on a variety of indicators even though they were younger when demonstrating their performance on the various achievement benchmarks.
- Gifted students appeared to become more strongly engaged in science, technology, engineering, or mathematical areas of study. There is no evidence in the research literature that gaps and holes in knowledge have occurred as a result of student acceleration.

In the case of gifted (or academically advanced) students who are advanced in their skill and concept attainment and can learn new material at a much more rapid rate than their same-age peers, it is the professional judgment of those in gifted education that they need a curriculum that is differentiated (by level, complexity, breadth, and depth), developmentally appropriate, and conducted at a more rapid rate.

Support also was found for supplemental enrichment programs. Of the two programs analyzed, one explicitly utilized acceleration as a program component and the other did not. Self-paced instruction supplemented with enrichment yielded the greater benefits. This supports the widely held view in the field of gifted education that combined acceleration and enrichment should be the intervention of choice.

Recommendation: **Mathematically gifted students with sufficient motivation appear to be able to learn mathematics much faster than students proceeding through the curriculum at a normal pace, with no harm to their learning, and should be allowed to do so**.

There is a need for more high-quality experimental and quasi-experimental research to study the effectiveness of interventions designed to meet the learning needs of gifted students. Especially vital are evaluations of academically rigorous enrichment programs.

It is important for school policies to support appropriately challenging work in mathematics for gifted and talented students. Acceleration, combined with enrichment, is a promising practice that is moderately well supported by the research literature, especially when the full range of available literature is considered.

On March 13, 2008, the National Mathematics Advisory Panel presented their Final Report 2008.

Copies of these ground-breaking reports, rich with information for parents, teachers, policymakers, research communities, and others, are provided at http://www.ed.gov/about/bdscomm/list/mathpanel/index.html

Tips for Parents: Parenting Math-Talented Students

by Ann Lupkowski-Shoplik, Ph.D.
Davidson Institute for Talent Development, Parent Seminar

". . . students who accelerate in math tend to take more math, study higher levels of math, and pursue careers that use their mathematical abilities compared to equally able students who do not accelerate."

Diagnostic Testing-Prescriptive Instruction

The Diagnostic Testing-Prescriptive Instruction (DT-PI) model is useful for tailoring instruction to exceptionally math-talented students. This includes aptitude testing (using above-level tests such as EXPLORE or the SAT), and achievement testing to determine what the student has already learned. The mentor uses the information provided by the testing to design instruction and spend the majority of time working on new material rather than reviewing concepts the student has already mastered. After instruction, the student is again tested with an alternate form of the pretests to determine mastery. Then, the student can move to the next level and the process can begin again.

The DT-PI process has been used extensively in the summer programs offered by university-based talent searches. In these programs, talented young people can complete one or more years of mathematics in a few weeks. This process can be applied during the school year as well, so that students are able to move through curriculum they have already mastered and spend their time studying new information. Sometimes mentors work one-on-one with a student outside of school, and sometimes mentors are assigned to work with small groups of students as part of a school-sponsored program.

We recommend that the student work one-on-one with the mentor (or in small groups with other talented students with the mentor) a total of 2 hours per week. During math time, while other students in the regular classroom are doing their seatwork, the accelerated student can work on mentor-assigned homework.

Finding a mentor

Certified teachers, retired engineers, and college students pursuing education degrees have made excellent mentors. The first requirement is that the mentor should know the math and be good at communicating that to students. It seems to work best if the mentor is a certified teacher. School personnel tend to accept certified teachers' recommendations more readily and would therefore be more likely to give credit for work completed with that mentor. Parents can locate mentors by looking within their local school district as well as contacting the math department or math education department in local colleges.

Benefits of Math Acceleration

Bright students who are accelerated in math experience a curriculum that is more closely matched to their academic needs and abilities. They also benefit from being placed with other students who have similar abilities. Accelerated students who are placed in a regular class at a higher grade level are more likely to receive credit for work completed (compared to students participating in an outside-of-school program such as independent tutoring). Subject-matter acceleration is a relatively easy, inexpensive way for a school to provide instruction at an appropriate level for math-talented students. This has long-term positive effects as well: students who accelerate in math tend to take more math, study higher levels of math, and pursue careers that use their mathematical abilities compared to equally able students who do not accelerate.

Drawbacks of Math Acceleration

Accelerated students may not have a lot in common with the older students in the classroom. Steps should be taken to ease the

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transition for the young student. If the receiving teacher is not in favor of the acceleration, the transition can be difficult. Other challenges include scheduling (if the math class is at the same time as another important subject) and transportation (if the desired class is in another building).

What should we consider when accelerating young students in mathematics?

- Students need to be challenged in mathematics throughout their school years.
- Students should have a strong mathematical base. They need to have a good number sense and a good understanding of arithmetic before plunging into advanced mathematics.
- Rather than randomly presenting interesting math problems at the students, it's better to provide a systematic process for them, so they study mathematics in an organized fashion and ideas are allowed (and encouraged) to build upon each other.
- Some children are ready for algebra in 5th grade or 4th grade, maybe even younger. We do have to satisfy ourselves that they have a good understanding of pre-algebra concepts. The Diagnostic Testing-Prescriptive Instruction model is very useful here.
- Two useful tools that were specifically designed to measure students' readiness for algebra are the Iowa Algebra Aptitude Test (Riverside) and the Orleans-Hanna Algebra Prognosis Test (Harcourt Brace Educational Measurement). Both of these tests have been used successfully to measure young student's readiness for algebra. Either test can be administered by a teacher.

Writing Down Your Thinking

Math-talented students need to learn this important skill. If the work is too easy, the students are likely to continue solving the problems in their heads and develop poor study strategies. When students are given more challenging work, they are more motivated to write down their thinking. To continue encouraging this type of behavior, offer to be a scribe for your child (some—not all—the time!), have a discussion about how he approached solving the problem, ask her to record how she solved it on a tape recorder, or have him write it on a blackboard or whiteboard rather than on paper.

Above-level Testing

For talented students, above-level testing is critical. This means using a test that was designed for older students. For example, the EXPLORE test, which was developed for 8th graders, is used for academically talented 3rd-6th graders because it raises the "ceiling." It allows us to have a long-enough yardstick to measure their math talent. Above-level tests also allow us to differentiate talented students from exceptionally talented students, which is useful in tailoring advice to a specific child's abilities and needs.

We also need to measure math achievement. Although an aptitude test (such as EXPLORE) tells us a lot about a student's abilities, it doesn't give us enough specific information about topics the student has mastered or has not mastered. Achievement tests are designed to gather this information. Examples of achievement tests include the Stanford Diagnostic Math Test, the Sequential Tests of Educational Progress (STEP), and the Comprehensive Testing Program (Educational Records Bureau).

Online Math Programs

One of the major benefits of studying math via an online mathematics program is the opportunity to study a subject at the right

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"If the work is too easy, the students are likely to continue solving the problems in their heads and develop poor study strategies. When students are given more challenging work, they are more motivated to write down their thinking."

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level of challenge. The student can work at his or her own pace and at the right level. One of the most difficult aspects of online math programs is that the student should be highly self-motivated and an independent learner. Some students thrive in this atmosphere, others feel isolated and find that they prefer being in a classroom setting. To give a student participating in an online program more opportunities to interact with others concerning mathematics, consider joining a math club or participating in math competitions. Participating in a summer program offered by one of the university-based talent searches provides the appropriate level and pacing while also keeping the student with a true peer group.

Some Final Thoughts

- Objective information about your child's abilities and achievements in mathematics is critical. Have your child tested (in school or privately) using above-level tests. Take the time to understand your child's test results. Objective information obtained as a result of the testing is much more powerful to school personnel than opinions of parents or others. However, parents' observations of the kinds of things your child enjoys doing, a portfolio of math projects, and a list of math programs that he or she has enjoyed combine with objective test results to give a more complete 'picture' of the student's abilities and needs.
- Parents may need to educate school personnel, if the school personnel have not had the opportunity to learn about gifted students, specifically math-talented students. Some useful resources are included below.

Resources

- Assouline, S. G., & Lupkowski-Shoplik, A. (2005). Developing Math Talent: A Guide for Educating Gifted and Advanced Learners in Math. Waco, TX: Prufrock Press.
- A Nation Deceived: www.nationdeceived.org summarizes the current reseach on acceleration. Please share this information with school personnel!
- George Lenchner's Creative Problem Solving in School Mathematics (available from www.moems.org).
- Ed Zaccaro's Challenge Math (http://www.challengemath.com/)
- Talent Search programs (such as those offered by Johns Hopkins, Carnegie Mellon, Northwestern, Duke, the University of Denver, and the University of Iowa) provide testing as well as classes for exceptionally talented students.
- Distance learning programs include EPGY at Stanford University (http://epgy.stanford.edu/) and the University of Nebraska-Lincoln online high school (http://nebraskahs.unl.edu/index.shtml) .
- Some excellent enrichment resources can be found through Dale Seymour Publications.
- http://plgcatalog.pearson.com/co_home.cfm?site_id=11
- Another excellent website is Math Forum (www.mathforum.org) (try out the Ask Dr. Math section and the Problem of the Week).
- www.hoagiesgifted.org/math.htm contains links to other sites your child might enjoy.
- The SOMA cube: http://www.fam-bundgaard.dk/SOMA/HISTORY.HTM
- The Math Olympiads for Elementary and Middle School Students (www.moems.org) provide challenging problems for students but do not require an understanding of algebra.

Wanted: Newsletter Editor

No Experience Necessary

Learn about gifted children and gifted education while putting together the AAGTS Newsletter. Four issues per year. Benefits include free admission to AAGTS Annual Conference, networking with gifted administrators and educators in public and private schools, an opportunity to attend the NAGC (National Association for Gifted Children) Annual Conference. For more information e-mail Lori MacKenzie at dnlmac@q.com.

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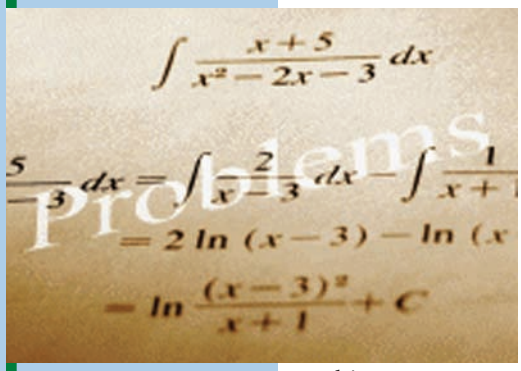
Gifted Child Quarterly *(GCQ) is the scholarly journal of the National Association for Gifted Children, publishing manuscripts offering new information and creative insights about giftedness and talent development in the context of the school, the home, and the wider society.*

Parenting for High Potential *is the quarterly magazine designed for parents who want to make a difference in their children's lives, who want to develop their children's gifts and talents, and who want to help them develop their potential to the fullest.*

To find out more about these publications, visit the NACG web site at http://www.nagc.org/index.aspx?id=34&pb

Eight Considerations for Mathematically Talented Youth



by Julian Stanley, Ann Lupkowski, and Susan Assouline

Since its founding by Julian C. Stanley in 1971, the Study of Mathematically Precocious Youth (SMPY) at Johns Hopkins University has strongly advocated subject-matter acceleration for students who are *extremely* talented in mathematics. SMPY staff members have conducted many research studies showing the benefits of such acceleration (e.g., Brody & Benbow, 1987; Brody, Lupkowski, & Stanley, 1988).

Although helping talented students move faster in an attempt to find a good "fit" between their high abilities and the school mathematics curriculum is favored, it should be noted that acceleration has been misused. Too often students speed through textbook after textbook. This constitutes an abuse of acceleration and inhibits studying mathematics in depth.

Many practitioners advocate the use of enrichment because it enables students to study mathematics in greater breadth than in the regular math class. While enrichment activities may relieve boredom, enrichment alone does not provide the substantive, continuous, hierarchical stimulation needed by students *extremely* talented in mathematics. For example, one mathematics enrichment program requires students to complete numerous "problem-solving" worksheets. Whereas problem-solving and other enrichment activities are of value for all students, they are not the optimal means of attaining in-depth programming for extremely talented students. For these students, a systematic accelerated curriculum, balanced with appropriate enrichment activities, provides the speed and depth needed.

"While enrichment activities may relieve boredom, enrichment alone does not provide the substantive, continuous, hierarchical stimulation needed by students extremely *talented in mathematics."*

This article focuses on how accelerative and enrichment options complement each other to provide appropriate challenges for talented students. The following eight important points are presented for parents, teachers and mathematically talented students to consider in planning an educational program:

1. Allow extremely talented elementary students time to develop the mathematical maturity needed to study algebra. Often parents and educators contact SMPY about mathematically brilliant youths in the age range 4-11 or so and they mention having the child study algebra right away. They usually are urged to go more slowly because students that young, no matter how brilliant, are unlikely to have a thorough background and firm foundation in general mathematics, the structure of the number system, arithmetical problem solving, or even Piagetian formal operative thinking.

2. Extremely few elementary students will have the necessary cognitive structures already well enough developed enough to do more abstract mathematics such as second and third year algebra, geometrical proofs, trigonometry, analytic geometry, and calculus effectively and in ways that will give them intellectual satisfaction. They may be like the person who can walk fairly well on his hands, but greatly prefers to use his feet, when not demonstrating mastery of the acrobatic stunt. For example, a child who excels at computation may use this mechanical skill to solve difficult problems without understanding the underlying concept. Mathematics as a stunt to please parents or educators is not likely to inculcate in the doer a love for the subject. Too much too early can cost the youngster pleasure in the subject, and the nation promising mathematicians or scientists. The authors have seen that happen a number of times.

3. For the mathematically brilliant youth, acceleration may provide the best

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educational option. Although in points 1 and 2 the reader is cautioned against rushing into fairly abstract mathematics, acceleration may be the option of choice for the extremely mathematically talented youth. For a small percentage of children, moving ahead in mathematics and related subjects such as physics and computer science more rapidly than their classmates is the only way to provide the best fit for their educational needs.

Identification of Other Abilities

Identification of exceptional mathematical talent usually occurs in conjunction with the identification of other abilities. Some mathematically apt boys and girls have much better verbal ability, mathematical ability, special relations ability, nonverbal reasoning ability, etc., than do others. These are relevant to the pace and level of subject matter ideal at a given age. Also quite important and *somewhat* distinct from the above is tested intelligence ("IQ"), especially as measured at age 6-8 or so by a skilled tester using individually administered tests. The central office of many sizable school systems is usually equipped to provide achievement, aptitude, and intelligence testing, but parents, as taxpayers, may have to insist that an assessment be done. Otherwise, private, certified psychologists (who should usually have a Ph.D. degree) may be needed. This type of assessment can be rather expensive, but it may be worth the cost, especially when the psychologist helps parents and educators develop an individualized educational plan. SMPY advocates testing that results not only in identification of strengths, but also in specific educational programming.

Accelerative options may include entering school early, skipping an entire grade or advancing in math only. (For 13 ways to accelerate, see Benbow, (1979.) An excellent way to advance fast but efficiently in a subject is SMPY's individually-paced and mentor-guided program (Lupkowski & Assouline, in preparation; Lupkowski, Assouline, & Stanley, submitted; Stanley, 1978, 1979, 1986). Called the Diagnostic Testing-Prescriptive Instruction (DT-PI) model, it can be applied at any age level and provides an efficient mechanism for challenging extremely talented youth. Employing the DT-PI model in elementary school leads to the first course in algebra without undue haste.

4. The mathematically brilliant youth should be kept on a steady diet of highly satisfying mathematics at his or her appropriate level of mental functioning. This does not necessarily mean racing through the standard sequence in truncated periods of time. There is no need to study mathematics intensely every day; one weekly two-hour session with a mentor may provide the challenges and stimulation an unusually talented student needs. Pacing of this sort helps avoid a situation in which a student will not have the opportunity to study mathematics for long periods of time.

In addition to having students do mathematics continually, SMPY encourages them to seek balanced learning experiences. Activities in other academic areas (also in sports, art, music, drama, dance, student government, community service, etc.) should supplement accelerated mathematics.

5. The talented elementary student who moves ahead extremely fast in the mathematical sequence is likely to be catapulted beyond the offerings of the school system long before he or she graduates from high school. Usually, the youth who hurries ahead in mathematics will have to slow down too much at some phase, perhaps not even taking mathematics courses until at the right grade level to resume the sequence. However, if there is an excellent college nearby where the secondary student can readily take regular college courses part-time without jeopardizing his or her high

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"There is no need to study mathematics intensely every day; one weekly two-hour session with a mentor may provide the challenges and stimulation an unusually talented student needs."

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school education, this may not be a problem.

Conventionally, the progression is Algebra I-III, geometry, trigonometry, analytic geometry, at least two courses of calculus, linear algebra, differential equations, probability theory and statistics, and the various branches of "pure" mathematics such as analysis, higher algebra, mathematical logic, number theory, and topology.

6. Teachers, mentors, clubs, and competitions can enrich an accelerated mathematics curriculum for talented youths. Skilled mathematics teachers can offer supplemental problems that are more advanced than typical students can handle. A mathematics mentor can enrich or supersede the youth's mathematics curriculum and provide suitable pacing. The books by Lenchner (1983) and Saul, Kessler, Krilov, and Zimmerman (1986) and issues of *Arithmetic Teacher* and *Mathematics Teacher* are good places to begin finding challenging problems for talented students.

"Participation in clubs and contests offers students an enriching opportunity to develop their mathematical maturity and a chance to meet other mathematically talented students."

Participation in clubs and contests offers students an enriching opportunity to develop their mathematical maturity and a chance to meet other mathematically talented students.

A mathematically talented youth should consider every opportunity to hone his or her talents in competitions, from the Mathematical Olympiads for Elementary Schools and Mathcounts in junior high school to striving to become a member of the United States team in the annual International Mathematical Olympiad, and other major international events. In addition to moving ahead in mathematics and other subjects, students can study and understand the material at a deeper level than is typical. One young man who participated in the International Mathematical Olympiad said, "The whole thing has given me a much stronger feeling for math, ...a very strong foundation of elementary math. Stronger in some ways, probably, than many mathematicians who didn't spend so much time in elementary math" (Dauber, 1988, p. 10).

7. Summer programs offer varied opportunities for able students to forge ahead in mathematics. The truly mathematically talented youngster whose special abilities are recognized early should be made ready by age 12 or 13 to complete precalculus—i.e., through analytic geometry—quickly and well. This may be accomplished by attending one of the regional, residential three- or six-week summer programs conducted in various parts of the country by Johns Hopkins University, Duke University, Northwestern University, the University of Denver, Iowa State University, Arizona State University, California State University at Sacramento, the University of Wisconsin at Eau Claire, and other universities, colleges, or state departments of public instruction. Following the completion of precalculus excellently, the student fortunate enough to be in or near a high school that offers a good Advanced Placement Program Level BC calculus course may consider enrolling in it, even though far younger than the typical high school senior in such courses. This usually works well.

8. There are more-advanced "pure" mathematics institutes for students aged about 14-18. Two such programs are Professor Arnold E. Ross's famed one each summer at the Ohio State University in Columbus and the excellent one at Hampshire College in Amherst, Massachusetts. They require considerable love for mathematics and eagerness to immerse oneself in it (eat, sleep, and breathe mathematics) for a long period of time—six to eight weeks. This is not for everyone who finds regular school mathematics easy, but it is the golden opportunity for a few dedicated young students.

The goals for these youngsters are proper pacing, proper sequencing, plenty of

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stimulation, time for planning and contemplation, appropriately planned challenges, and continual reinforcement of worthwhile achievements. These goals can be accomplished best without unseemly haste. Don't plunge the quite-young student precipitously into algebra, set theory, number theory, or the like. Let those subjects come in the natural sequence as his or her talents unfold. Take the long view that leads to steadily increasing achievement and deep intellectual satisfaction.

Qualifying Scores for Summer Programs

A student younger than 13 with no formal training in algebra who earns a score of 500 or above on the mathematical portion of the SAT probably has the cognitive skills needed to master algebra and the courses that follow. A score of 500 is the 49th percentile for college-bound male high school seniors and the 64th percentile for college-bound females. The summer programs mentioned in Point 7 usually require students to earn this score in order to attend.

Students who participate in these accelerative programs need to make inquiries regarding high school credit for the special summer classes as well as the availability and scheduling of high school courses to compliment the courses completed in the summer program. *Before* taking one of the summer mathematics courses, students must be certain that it will be possible for them to continue with mathematics throughout high school in the school system, or at a local college, or with a mentor. The professionals of SMPY also encourage students to supplement their mathematics education by taking courses in physics, computer science, chemistry, and biology.

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Websites that Cater to Math and Science

http://demonstrations.wolfram.com/
The Wolfram Demonstrations Project is an open-code resource that uses dynamic computation to illuminate concepts in science, technology, mathematics, art, finance, and a remarkable range of other fields.

http://mathworld.wolfram.com/
MathWorld™ is the web's most extensive mathematical resource, provided as a free service to the world's mathematics and internet communities as part of a commitment to education and educational outreach by Wolfram Research, makers of *Mathematica*.

www.fractalfoundation.org

http://www.ocf.berkeley.edu/~wwu/fractals/fractals.html
An introduction to fractals. Topics discussed include fractals in nature and industry, and the basic mathematics behind generating several classic structures, including the mandelbrot set and sierpinski triangle.

http://www.artofproblemsolving.com/

http://www.edinformatics.com/math_science/gt_mathsci.htm
This site contains a list of more urls for science and math.

http://www.giftedstudy.com/resources/students/math.asp

http://www.stfx.ca/special/mathproblems/welcome.html

http://www.gifted.uconn.edu/projectM3/index.html
Mentoring Mathematical Minds. A national curriculum and research study to nurture math talent in elementary students.

http://www.smgproducts.com/
Science, math, and gifted products

http://epgy.stanford.edu/
Multimedia computer-based courses in a variety of subjects, including mathematics and physics, for bright students of all grades, offered through the Stanford Continuing Studies Program.

http://cty.jhu.edu/
A university-based initiative that promotes the academic experience of children with "extraordinary mathematical ability" worldwide.

http://www.nku.edu/~mathed/p12sr.html#prob
Mathematics Education at Northern Kentucky University: P-12 student resources

AAGTS

Albuquerque Association for Gifted and Talented Students (AAGTS)

MEMBERSHIP FORM

☐ New Membership ☐ Renewal ☐ Address Change

Name _____ Spouse _____

Street _____ City, State, Zip _____

E-mail address _____

Home Phone _____ Work Phone _____ Spouse's Work Phone _____

Are you an educator? ☐ Yes ☐ No If yes, school _____

Do you have a gifted child? ☐ Yes ☐ No If yes, their grade level(s) and school(s) _____

_____

Is your child twice exceptional? ☐ Yes ☐ No

Do you or your child need special assistance to attend workshops or meetings? ☐ Yes ☐ No

How did you hear about AAGTS? _____

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If yes, please list: _____

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