The reprint to the editor.

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Interdisciplinary Studies: Math and Science

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Growing up as I did, with my reading-obsessed highly gifted older brother, I had the opportunity to pilfer books from his extensive science fiction collection. The world of possibility contained in those books was mind grabbing, and I was soon hooked.

Science fiction addresses that wonderful question, “What if?” by taking what we know and integrating it with what could be. This example of integrating “facts,” with possibility, is a dynamic basis for learning. Possibility sparks wonder, which in turn helps ignite interest and enthusiasm. And young learners in particular require enthusiasm to make those wonderful connections and cognitive leaps within and between topics.

At its finest, science fiction blends multiple subjects, including science and history, cultural and civilization issues, the mathematics of space travel—really the list is endless. Intoxicating stuff.

Presenting studies in an interdisciplinary fashion so young students are primed for that “power of association” is vital. Yet, all too often our current system presents subject matter as stand-alone topics, which then lose much of their potential as that dynamic interdisciplinary basis for learning. Education is not at its best when subject matter is presented as a singular element with no relationship to any other, particularly for gifted children with their complex minds and often-rapid ability to draw relationships between subjects and seemingly unrelated items. Education should create opportunity to help children develop fully into who they are, and who they will become. The primary purpose should not be for them to memorize facts but to prepare them as best we can, all the while maintaining an interdisciplinary structure to help uphold their natural enthusiasm.

In this issue of the GEC, Carolyn Cooper writes, “Interdisciplinary studies do more than teach about the individual components of the relationship—in this case, math and science; they strengthen the combination itself, creating a new approach to understanding the power of that association.”

Robin Schader writes in her Making Connections column, “With such rapid advances in most disciplines, how can we responsibly ready our children for what their future will be? We know, at the very least, it’s going to take nimble, creative, and (to quote Pasteur) prepared minds.”

We may not know what the future will bring, but we do know that it’s our responsibility to prepare our bright-minded children through studies that give them ample opportunity for cognitive freedom, personal versatility, and the gift of enthusiastic learning.

In this, our first issue to be published online, we hope to further the integration of many disciplines through electronic means. As the process evolves, you should expect to find more links and Internet resources in the articles we present; this will make supplementary materials ever more accessible to both educators and parents.

You will have noticed that you had a choice of format when you clicked on to this issue. We know that many of you already look to online sources as a major mode of receiving information and are entirely comfortable with this mode. For you, there is the digital edition with automatic page turning. We thought others might be more comfortable with a conventional PDF format because it is closer in appearance and function to print copy.

As we begin this online publishing journey of the Gifted Education Communicator, we hope that there are things you especially enjoy. Please bear with us as we work out any kinks. And as always, we welcome your ideas and suggestions for improvement. I can be reached at GECeditor@aol.com.

—Karen Daniels, Managing Editor
We have been planning for many months for this issue focusing on math and science. The topic itself is of great importance, and the fact that one of the most significant advances of our time—computer science—allows us to publish our first online issue is exciting. We have indeed joined the 21st Century!

Our lead feature article is presented by Bill McComas, a longtime friend of gifted education at the University of Southern California who continues his support of gifted learners in his new position at the University of Arkansas. His article, “Educating Science Critics, Connoisseurs, and Creators: What Gifted Students Must Know About How Science Functions,” is particularly apt for those planning curriculum for gifted learners. While applauding the ever-increasing number of science courses available to K–12 learners, he notes a significant concern. “The content that is generally missing from science instruction relates to a discussion of the ways and means by which knowledge is generated and validated, a domain commonly called the ‘nature of science or NOS.’ He lays out the significance of the NOS in relation to critics, connoisseurs, and creators as students. And while doing so, he challenges myths regarding the time-honored six-step “scientific method.”

Carolyn Kottmeyer is a regular writer for this journal with her Web Watch column. As the Founder and Director of Hoagies Gifted Education Page, hoagiesgifted.org, we have come to depend on her knowledge of what is available on the Internet for parents and educators of gifted learners—and for gifted kids. Her great love is math and science, and therefore, we asked her to write a feature article this issue, allowing her to go into much more depth than usual. The result is, “Math and Science and the Internet: Exploring Cognito, Smithsonian Institution, NOVA, and Cool Math.” The depth and breadth of Cognito should prove especially helpful to all.

Craig Daniels calls himself a “math enthusiast” who lives in Portland, Oregon with two gifted daughters. He has been trained to facilitate “Math Circles” and volunteers at his children’s school to work with kids. He shares the basic process of facilitating math circles as well as an Internet site for you to find a math circle near you.

“Connecting Math to the Real World” is presented by Julia Candace Corliss who has worked with gifted students at the Mirman School in Los Angeles for the past 25 years. She presents concrete examples of how teachers can connect theoretical math to kids’ worlds.

The expansion of knowledge regarding the human brain is one of the most exciting advances in the scientific world. Wouldn’t it be beneficial to teach students just how their own brain functions? Barbara Clark does just that in her article, “Teaching Your Students About Their Brains.” She even provides scripts for both teachers and students in their exploration of brain function.

We are introducing a new department in this issue: RtI2 for Gifted Learners: Appropriate Intervention for Gifted Students. One of the many education hats worn by Beth Littrell is that of RtI2 Middle School Facilitator in the San Mateo-Foster City School District in California. RtI2 (Response to Instruction and Intervention) is currently being stressed in schools across the nation. But as in many other instances, emphasis is almost exclusively on students struggling in school—not the few “outliers” who have already mastered what is being presented in class. Beth has created a method of applying the guidelines used in RtI2 to make them work for gifted learners. This issue includes the first of a series of articles, all of which will provide specific lessons plans for classroom use. Appropriately, focus this issue is on math.

Best wishes for a great school year. Our Winter issue will be devoted to serving high school gifted students.

—Margaret Gosfield, Acquisitions Editor
CALENDAR OF CONFERENCES

2010

NOVEMBER 5–6, 2010
New York State Advocacy for Gifted and Talented Education
The College of New Rochelle, NY
nect.org

NOVEMBER 6, 2010
Minnesota Council for the Gifted and Talented
University of St. Thomas, St. Paul, MN
mct.net

NOVEMBER 10–12, 2010
Texas Association for Gifted and Talented
Fort Worth Convention Center, Fort Worth, TX
txgifted.org

NOVEMBER 11–14, 2010
National Association for Gifted Children
Georgia World Congress Center/ Westin Peachtree Plaza, Atlanta, GA
nagc.org

NOVEMBER 29, DECEMBER 1, 2010
South Carolina Consortium for Gifted Education
Charleston Place Hotel, Charleston, SC
scgifted.org

2011

JANUARY 13, 2011
Indiana Association for the Gifted
Indianapolis Marriott Downtown, Indianapolis, IN
iag-online.org

JANUARY 15–16, 2011
Higher Education Resources and Opportunities for Exceptional Scholars
New Brunswick, NJ
heroesgifted.org

FEBRUARY 6–8, 2011
Illinois Association for Gifted Children
Chicago Marriott Downtown, Chicago, IL
iaggifted.org

FEBRUARY 16–18, 2011
Arkansas Association for Gifted and Talented
Peabody Hotel, Little Rock, AR
agate-arkansas.org

FEBRUARY 25–27, 2011
California Association for the Gifted
Palm Springs, CA
cagifted.org

MARCH 3–4, 2011
Nebraska Association for the Gifted
LaVista/Omaha Conference Center, La Vista, NE
negifted.org

MARCH 11–12, 2011
New Jersey Association for Gifted Children
Crowne Plaza Somerset-Bridgewater, Somerset, NJ
njagc.org

MARCH 17–18, 2011
North Carolina Association of Gifted & Talented
Marriott and Embassy Suites Hotels, Winston-Salem, NC
ncagt.org

APRIL 29–MAY 1, 2011
Beyond IQ (BIO) Boston
Chelmsford Radisson, Chelmsford, MA
giftedconferenceplanners.org

JULY 10 (BEGINNING), 2011
Confratute
University of Connecticut, Storrs, CT
gifted.uconn.edu/confratute

JULY 15–17, 2011
Supporting Emotional Needs of Gifted
Seattle, WA
senGifted.org/conference

AUGUST 2011
World Council for Gifted and Talented Children
Seoul, Korea
worldgifted.org

OCTOBER 20–21, 2011
Nueva School
Nueva School, Hillsborough, CA
nuevagiftedconference

NOVEMBER 3–6, 2011
National Association for Gifted Children
Atlanta, GA
nagc.org

CAG “TAKing CHARGE OF CHANGE”
49TH ANNUAL CONFERENCE
February 25-27, 2011
Palm Springs, CA

For more information, visit cagifted.org

UPCOMING ISSUES
OF THE GIFTED EDUCATION COMMUNICATOR
Winter - Serving High School Gifted Learners
Spring - Effects of Technology on Gifted Learners
Summer - Alternative Options

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Making Connections!

Ten years ago, in a research study with 394 female U.S. Olympians, I looked for clues about the roles parents had played in developing these elite athletes. One of the women used a wonderful phrase—she characterized her parents as “opportunity makers.” Think of the richness of that phrase and the ongoing implications for all parents.

Erin Warren, a two-time Olympian in the women’s single luge, a sport not offered in schools, reported she would never have known about luge (in which she held the American record) had her father not suggested during a dinner conversation that she and her siblings give it a try at an upcoming community event. As she explained, “We were a typical American family, but maybe what was unusual was that both my mother and father were really great about sniffing out the opportunities and laying them in front of us saying, “Maybe this is something that you kids would like to do.” They would scour newspapers, fliers, whatever, and they would make different things available. Now when I see an opportunity I’m not afraid to try it.”

As those who stand most directly at the center of children’s lives, parents are natural hubs for making connections. Yet it’s a role we too often underestimate and undervalue. There are many ways we can help children see and understand connections. This includes—but certainly is not limited to—relationships among the subjects and across the topics they are studying; the relevancy between what’s being taught in the classroom and their lives; interests beyond school walls; and perhaps above all, how to develop understanding of connections among people.

Here are some tips to consider.

Connect classroom learning and appropriate school behavior and expectations to real life interests. Current neurological research confirms that effective learning results from engagement. It’s the enthusiasm, excitement, and energy that emerges from passionate interests that fuels good learning.

In the best of circumstances, it’s easy to make the connection. For example, an eager reader is motivated to learn and practice reading. With more reluctant learners, helping a child see connections might take careful observation and creativity. Do it with a sense of play. Rather than forcing an agenda, parents might take a page from the “Pied Piper” as they draw their child into the process of learning.
Consider a child who shows an interest in baseball. Think of the many ways to link this interest to academics while supporting and encouraging the child’s love of the sport. Plan to watch a specific game together. In preparation, investigate the two teams. Where are they from? How long have the teams existed? Where do the team members come from? Spread out a large map and find the different hometowns. Questions like this can encourage the development of research skills. What about a library trip or a visit to a baseball museum?

Incorporating math is a natural with baseball: scores, tallying averages, statistics. How about science and the physics of baseball, including knuckleballs and curve balls? What about the playing field—is it a diamond or a square? What about the different kinds of bats? It’s possible to build a web of learning, recognizing connections within and among the different subjects (incorporating history, geography, math, science, language, art, and, of course, reading, among other subject areas) . . . all by using your son’s or daughter’s love of baseball as a jumping-off place!

Connect seemingly disparate ideas. It’s obvious that our world today is remarkably different from the world of the last century. With such rapid advances in most disciplines, how can we responsibly ready our children for what their future will be? We know, at the very least, that it’s going to take nimble, creative, and (to quote Pasteur) prepared minds. A prepared mind is one that not only practices and masters basic learning skills, but also collects and synthesizes ideas, observations, and experiences. A prepared mind is aware and open. In fact, the more experiences, the more curiosities—along with time for quiet contemplation—the greater the odds that useful connections can be made between and among the collected information. It’s no secret that great creative advances occur when a prepared mind meets the right cluster of circumstances.

Once you begin looking, you may be surprised at the number of fascinating connections in biographies, as well as historical obituaries, of people (well-known or not) who have made creative contributions. For example, take a look at the life of Rear Admiral Grace Hopper (1906-1992) who helped develop the first commercial computer in 1951. As a child, her parents allowed her to satisfy her mechanical curiosity by taking apart household appliances. Her grandfather, a civil engineer, supported her interest in geometry and mathematics. She was encouraged to take physics and engineering in college. Yet, as you’ll read in her biography, it took the added connection from her days playing women’s basketball to give insight into how she could write programming language, using the concept of making a back and forth forward pass routine.

Finally, while parents can model making connections by telling stories of what they see and learn each day, it can be a big challenge for parents to let children find connections on their own. Making relevant connections is personal—highly dependent on individual circumstances, prior learning, and experience. Connections made for children simply don’t pack the “aha” power!

Connect with people. What good are fantastic ideas if you can’t inspire others to put them into practice? People skills are essential and parents provide profound role models for how to work with others. Adults know that being intelligent doesn’t directly translate into success—kindness, consideration, and an understanding of what motivates others are necessary ingredients.

Building networks of relationships is another example of making people connections. In 1929, one of Hungarian author Frigyes Karinthy’s characters proposed that any two people can be linked through five acquaintances (later called “six degrees of separation”). Is that still a valid assertion? What a provocative topic for dinner discussion, especially in light of the relationships that can be discovered on Facebook and Twitter (and, moving into this subject offers a natural connection for talk about social networking media—another area for thoughtful parental guidance.)

Finally, keep family conversations alive. Improvise and build on the strategies outlined above. Encourage connection-making, creative thinking, and positive problem solving by offering opportunities to practice these skills, along with opportunities to see them in action—being used by their parents in real-life, daily situations. You’ll find when parents and children regularly discuss ideas, share observations, and talk about experiences, they become “partners in learning”—ready to make connections and ready to make the most of the opportunities that come their way.

ROBIN SCHADER, Ph.D., is the Parent Resource Advisor for the National Association for Gifted Children (NAGC). Her research, teaching, writing, and workshops have focused on parental influence in talent development, as well as the ways parents and teachers can work together in recognizing and supporting high ability children.

It’s no secret that great creative advances occur when a prepared mind meets the right cluster of circumstances.
ne of the most concerning findings I know is that when suicides occur on college campuses—and, of course, though infrequent, they do happen—it’s more often the good students who are the victims, not those who are flunking, as one might expect. The tragedy is all the more upsetting and confusing to family and classmates who saw the student as “doing so well.” Don’t get me wrong—we have no evidence that gifted students commit suicide more often than do other young people. But when they do so, it’s usually during the first year after leaving home with everyone’s high expectations, and entering the big arena of a relatively competitive college.

One predictable source of deep despair among college students is specific to very high achievers who encounter even higher achievers for the first time, and suddenly lose their self-image as the highly touted “best student ever.” Many have been praised all their lives for how smart they are, and now they’re scared. The proverbial bright little fish in a big pond is lost in what feels like an ocean, without the reliable identity, reputation, and pride that has been theirs since they entered preschool. This situation is totally preventable, but its sources start early and are often unwittingly abetted by adults who innocently and lovingly “set them up.”

PLACEMENT DECISIONS

Some of the essential decisions that adults make for bright children relate to issues such as when to enter school, what sort of school or class to look for, how swiftly to move ahead in a subject or a whole grade, and what sorts of extra-curricular activities to choose. With the best of intentions, parents sometimes delay for a year enrolling their children with summer birthdays (especially boys) or decline their children’s opportunity for an advanced program in the primary grades because the children seem so happy with school and are “doing so well.” For typically developing children, these might be good decisions, but for children with advanced abilities, effortlessly being top (or “above the top”) of the class often teaches the expectation of success without investment, without ever being confused by something that is hard to understand, of having to try and try again to solve a problem. Their identities depend on being smart rather than learning and growing—on being “better than others” as if they were minor royalty to whom others must pay homage. How are they to know any better?

It would be natural to assume that such high-achieving children would thrive and grow self-confident and resilient. You’d think that they would feel sure that they have plenty of extra reserves they’ve never needed to use. But that’s not how it works. Having never been tested, they have no idea how they will respond to a true challenge. They’re fearful of how they’ll handle the inevitable when it comes along. You don’t learn coping strategies by never having to cope! Strength comes with mastering the difficult, not the easy.

The obvious way to avoid this threatening situation is to choose a setting, or a combination of settings, in which your children will not automatically dominate the class—indeed, the right setting may be one in which your child is not the top of the class even with concerted effort. To find this “sweet spot,” some compromises may be necessary. You need to take into account your children’s social skills and maturity (more about this later), motor skills, the quality of teaching in one setting or another, the probability of classmates who are engaged and serious students, and practicalities such as cost and transportation. But one of the most important factors to consider is whether your child will fit in—be part of a group that shares abilities, energy, and a love of the new and unsolved—perhaps even the unsolvable. It’s this kind of group that will offer your child a feeling of belonging, comfort with making errors and asking questions, and relief from the burden of always being in the lead. At the same time, the level of rigor will be in the right range—sufficient that your child will stretch and learn, but not so great that it becomes aversive.

There are several ways to address this issue depending on the choices available. These include the familiar ones, of course: early entry to school; grade skipping; subject-based acceleration; special programs, classes, or schools; dual enrollment; and on-line courses to substitute...
for those the school can’t provide at an appropriate level. These are all basic choices that make a fundamental adjustment in children’s ordinary school experience. There are also complementary options that may be helpful, such as in-school pull-out programs; after-school book clubs (you might think of starting a parent-child club or introducing Junior Great Books); all sorts of skill groups in sports (including martial arts); musical instruments and orchestras; dance, drawing, and clubs devoted to preparing for contests in math, spelling, chess, geography, or the sciences. Again, the principles are the same in settings in which your children fit as well as where they aren’t necessarily always first or best.

And, finally—likely to be the most powerful influence of all—are your own expectations that your children will take responsibility to find their own challenges. Teachers and parents can help. Settings easily to them! If, as you hope, they have ambitions for a demanding career that makes a difference in this world, it’s going to take a good deal of their investment, but they haven’t a thing in the world to prove to you about how smart they are.

QUESTIONS PARENTS ASK

What if my child’s social skills don’t equal the maturity of the setting he might enter? Then grade skipping may not be the answer—at least not for now—but there are still lots of options left. Maybe you can find some opportunities for him to mix with cross-age groups outside of school to learn those skills.

What if grade-skipping is the only option in our school, and it scares me? Try it. See if it will work for your child, but let everyone know it’s an experiment.

You don’t learn coping strategies by never having to cope! Strength comes with mastering the difficult, not the easy.

make a big difference; but the real difference is what the student brings to the table in terms both of experience-seeking and personal responsibility for pushing beyond the required minimum or following a special interest. (Of course, this will be a good deal easier to teach your children if you push your own boundaries as well!)

MESSAGES TO GIVE YOUR CHILDREN

If this book is too easy, find a more complex and/or deeper one on the same topic. If “biology is boring,” find out why so many bright people spend their entire lives pursuing questions in this area. If you’ve already mastered the math concepts in your homework, try applying them to real-life problems; or making them more complicated; or asking the teacher if you can work ahead on your own. If the spelling words are too simple, make up your own list from your independent reading. If you “hate” writing long essays, practice keyboarding every day so that you can devote your energy to what you want to say rather than the mechanics of getting it on paper. And have the courage to seek out experiences in which you are pretty sure you won’t be an instant expert—whether sports, a new realm of art you haven’t yet tried, or trying out for a team at a level you’re almost ready for but maybe not quite.

In the process of such explorations, your children will discover that there really are a lot of smart people out there, some much more talented than they are! And that this is a very good thing to know! Be sure that your children fully believe in their heart of hearts that the way you feel about them does not depend on their level of attainment. Of course you want them to be engaged and growing. You’d much rather that they opt for interesting opportunities than those they can master without work, although, paradoxically, don’t let them devalue those things that do come

What if there’s an independent school that would be a good match, but it’s too expensive? Most schools offer financial aid. You might also want to consider using such a school just for the most critical years such as middle school.

My child’s teacher offers little help in her seeking more advanced material and seems to worry that she will “run out of things to learn!” Not a chance! Your child’s best friend may be the librarians at school and at the public library. The Internet is full of leads, but do get real books and activities into your child’s hands.

My child used to lead her class and typically went beyond the required in her studies, but she’s recently turned away from that. She says it’s much more important to “be like everyone else,” and her friends certainly discourage her independence and her high achievement. This is a time when your children need you more than ever to keep your expectations high. You can help them by playing the “mean old parent” without whose demands they certainly wouldn’t do the extra-credit work or write such long essays or practice the piano two hours a day. This way, they’ll get the secret pleasure of the invigorating challenges, disguise their motivations until they’re ready to claim them again, and get loads of sympathy about the ogres they have for parents! Grrr!

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An Elegant Solution
The Math-Science Relationship in Our World

By Carolyn R. Cooper

The elementary curriculum today includes combinations of some subjects. “Language arts,” for example, comprises the fundamentals of English grammar, writing techniques, reading, and spelling. “Social studies” combines history, geography, fundamentals of government, and even a bit of anthropology in some cases. Few children in the United States even know what a geography book is. The closest most students come to one is the road atlas they use to find a map.

And science. Historically, science education in America was one of the weaker links in the elementary curriculum. Not until the United States began to understand the potential of the Cold War’s influence on Americans’ safety, did science take its rightful place in the elementary curriculum. Until then, many school districts throughout the country considered “science” a subject studied in a high school laboratory.

Science in the real world outside of the classroom comprised countless other components, however; it offered an ideal environment for “what if” thinking; it posed opportunities for challenging long-accepted theories; and it encouraged experimentation with numerous variables being developed by university personnel working long hours in laboratories to find answers to questions plaguing America’s brightest minds.

“INTERDISCIPLINARY” STUDIES: MATH AND SCIENCE WORKING TOGETHER

The concept of studying math and science in combination is not new to today’s educators or their students. Decades have passed since these disciplines were separate entities in the curriculum, as noted above. In my early days of teaching, my students had a book for each subject, and most of our staff, as I recall, did not blend the two in any way.

A few of us younger teachers, however, appeared to recognize the natural bridges between math (“arithmetic”) and science. For my eagerness to combine subjects in a more holistic way of understanding the world, I credit my early education in one-room
The overlap of math and science sent a message that no longer could these two fields be separate, self-contained entities.

country schools in rural New England. For my first five years of school I was the single student in my grade. That situation opened to me marvelous opportunities to join older students for subjects I learned readily as well as time to study on my own—with help from the teacher—the subjects I found more difficult. Unfortunately, science was absent from our elementary curriculum which became problematic for me when my family moved to a larger community whose school placed all students of the same age in one classroom. Raised on a farm, I knew much about animals, crops, and the long-term effects of sudden storms on our freshly-mowed hay, but “school science” baffled me.

As a young teacher, I worked diligently to further understand the science concepts I’d learned about in my teacher education courses. And the more I dissected the concepts I’d be teaching my students, the more I realized how math and science were connected. With the Soviets’ surprise launch of Sputnik an all-too-recent memory, the relationship between math and science was clear: There was an elegant solution to questions that both disciplines were posing. The overlap of math and science sent a message that no longer could these two fields be separate, self-contained entities.

Science used math, and math relied heavily on science. Mathematical formulas became the province of science labs, as did beakers, weights, and Bunsen burners. In the field of medicine, math continued to play highly-significant roles from developing prescription drugs and other antidotes for curing patients, to perfecting prosthetic limbs whose measurements and capabilities needed to accurately replicate the functions of limbs lost in battle, accidents, or from disease.

Today’s space travel is an exquisite example of how intertwined math and science have become in the advancement of both disciplines. Payloads, for example, must be perfectly balanced; too much weight in any one component may cause lift-off to be scrubbed until a costly correction is made. This issue is relatively simple when compared with the intricacies of time travel, black holes, and trips into space to determine the very beginnings of the universe. Does math play a singular role? Hardly! And how does science fare with sifting through photos the Hubble Telescope and other grand instruments used to understand our solar system? It’s elegantly clear that a symbiotic relationship not only exists between math and science but is very much alive and well.

HOW ADMINISTRATORS CAN REINFORCE THE MATH-SCIENCE RELATIONSHIP

Math and science are vital to advancements in space research, farming, underwater oil drilling, road construction, medicine, and…you name it! The list is virtually endless. Interdisciplinary studies do more than teach about the individual components of the relationship—in this case, math and science; they strengthen the combination itself, creating a new approach to understanding the power of that association.

Finally, students taught that examining and working firsthand with the combination of the two disciplines yields a far deeper understanding of the numerous roles the math-science relationship plays every day of our lives. To reinforce this critical fact, administrators might implement the activities shown below.

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<th>CONTEST</th>
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<th>SHARING RESEARCH</th>
<th>PRODUCT DISPLAY</th>
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<td>Find and record the most examples of math and science working together in our school.</td>
<td>Create ways in which math and science can overlap to improve a classroom.</td>
<td>Find examples of math and science working together in your home and take photos of this relationship, if possible.</td>
<td>Invite emergency personnel (police, ambulance, fire) to school and share with students techniques they use that rely on a math/science solution.</td>
<td>Develop a directory of businesses in our community that combine math and science in their work. Present it at a Board of Ed. meeting.</td>
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Appropriate Intervention for Gifted Students

In her seventh edition of *Growing Up Gifted*, Barbara Clark reminds us, “Integration, constant feedback, and vast experience in a rich environment are the keys to powerful learning and memory. What we believe about how people become intelligent will influence the way we plan for their educational development. High levels of intelligence are the result of a dynamic, stimulating process that leads to quantitative and qualitative differences in brain function.”

I was sitting in an Education Week webinar about RtI² (Response to Instruction and Intervention), reflecting on a conundrum related to early intervention for those who need help. The slide, presented by Amanda M VanDerHeyden, showed a parabolic curve in which one student had 89% mastery of a concept before teaching. The class mean was 21% with a median of 17. Of the two proficient students, the second had 60% mastery of the concepts. Nine of the nineteen students scored less than 10%. The next slide encouraged schools to rule out inadequate instruction as a cause for under-performance; the accompanying conversation explained how targeted, appropriate instruction often led to proficiency. It was noted that appropriate instructional strategies needed to be employed before moving to intervention. The next presenter was Evelyn Johnson of Boise State University. She discussed how professional learning communities and data-based decision making led to continuous school improvement. Kristen L. McMaster from the University of Minnesota was the third presenter in the webinar. She urged us to set goals for students, and then progress-monitor to see if student achievement was progressing along the slope determined by the annual goal.

Although I was attending the webinar to learn about the needs of those outlier students who were scoring far below proficiency, I couldn’t stop thinking about the one outlier who had mastered 89% of the content before the teacher began instruction. That afternoon, I began collaborative discussions with colleagues in gifted education to see how we might use the impetus of RtI² to focus on student potential and achievement for all students, including those who are gifted and talented. If we were to pre-assess students, set an annual goal based on the current levels of performance, and then progress-monitor and adjust instructional strategies so that the learning curve for the student matched the anticipated success, I believe we would see the high levels of intelligence that Dr. Clark first mentioned in 1979 and continues to subscribe to in her latest edition.

This series of articles will begin to describe some possible instructional and intervention plans for those outlier students who mastered the concept before the teacher entered the room. In keeping with the math and science theme of this issue of the journal, this article will include a plan for instruction and intervention in math.

**Learning is not a spectator sport: integrating all brain functions**

Dr. Clark’s discussion of integration is far more than an interdisciplinary approach to teaching. She urges us to integrate the
## RESPONDING TO THE INSTRUCTIONAL NEEDS OF GIFTED STUDENTS WITH APPROPRIATE INTERVENTION

### Learning Goals and Outcomes
The area of a region is much more efficient as it approaches a square. What will students know or be able to do after this lesson? Calculate area and perimeter, make generalizations.

### Pre-assessment
What product or assessment will show you what students already understand? Students will take the post-test as a pre-test.

### Anticipated challenges in the lesson
What concepts might be difficult? Which student(s) will need additional depth or complexity? Some students will already know how to calculate area and perimeter. Finding the ratio between the length of the rectangle and the area that it encloses will be new to most. Very few have experiences with generalizing “rules” about mathematics from the observations in an inquiry.

### Opening: How will you engage students?
Connections to prior knowledge, expertise, interest, or talent: Go outside and form matrices of 24 students (24 x 1, 12 x 2, 8 x 3, 6 x 4) Ask students to describe what they notice about the space they occupy in each of these formations. Notice various matrices on the school campus (arrangement of classroom space, placement of buildings, parking spaces... Ask students to find patterns related to the use of space.

### Social-emotional (Responsive Environment)
What evidence exists of a safe, welcoming environment? How have you encouraged intellectual risk-taking? How will you incorporate appropriate humor? Allow students to work individually, in partners, or in small groups. You might allow students to work in square inches or in cm² depending on their ability to manipulate the tiles. Using Grinder’s model for exit directions will ensure that all students understand the task at hand. Be sure that students know and follow the procedures for gathering and managing materials. Use questioning to prompt students instead of explicit steps.

### Sensory engagement: How will you use music and other sounds, movement, texture, or other tactile inputs?
Taste and/or olfactory senses? After the kinesthetic model and visualization exercise (see Intuitive function), begin with 1 cm² or in² area tiles. Ask students to arrange 24 tiles in various rectangles and record their areas on a data table (scaffolding for the data table will vary between groups of students, and struggling students will probably do this in a guided practice session with the teacher for the first 3-4 rectangles. For students who can move quickly from the concrete to the abstract, it is important to request the tactile manipulation for at least the first one or two rectangles.

### Intuitive function: How will students make intuitive predictions?
How will you incorporate imagination and visualization? How will students share their insights? Ask students to visualize a garden (before or the manipulatives depending on the age and experience of your students). Direct them to mentally lay out the tiles, eliciting color images that engage the senses. Allow time for students to write about the patterns they noticed in the opening exercise, and then provide time for them to share their findings with classmates.

### Resources and Materials
Print, manipulatives, media / technology, mentors, other. Tiles, math journal, calculators, straight edge, graph paper.

### Cognitive Function
What information do you want students to know? What information or processes do you want students to apply from prior learning or experience? How will students analyze, synthesize, and evaluate?
**Knowledge:** Area and perimeter definitions, procedures for the investigation.
**Comprehension, Application:** Students will need prior knowledge of how to create and test a hypothesis. Because this is a progressive problem that becomes more and more difficult, application is key to the ultimate solutions.
**Analysis, Synthesis:** Graph the relationship of the length of the garden, and create a generalization to discuss the ratios.
**Evaluation:** Prove with evidence that the generalizations are correct.

### Progress Monitoring
How will you monitor progress throughout the lesson? In conference with individuals, partners, or small groups, ask students to explain how they got their answer, and how they know that it is right. It is this metacognitive discussion in math that will tell you whether the student is simply completing a task or constructing understanding.

### Strategies for Intervention and Small Group Management
What will students do when they finish assigned task(s)? How will you modify or accommodate students who need a different pathway? Students will begin with manipulatives, and have gradual release from guided practice as they begin to learn how to solve the problem. Those students who are facile with problem solving will have more independence, and will check in with teacher for metacognitive process talks instead of guided practice (how do I know that I am correct?).

### Reflections and Self-evaluation
How will your students reflect on their successes and challenges in the lesson? As the lesson progresses, take some time at the beginning and/or end of each session to ask students both process and content questions. “How are you solving these problems?” “What difficulties are you encountering?” “What surprised you in the findings?” “How might you change your problem solving strategies today based on these experiences?”
brain functions of sensory perception, cognition, social-emotional factors, and intuition. Learning is not a spectator sport. Marian Diamond taught us that dendritic density and complexity was directly related to the intellectual struggle initiated and sustained by her laboratory rats.

**Engagement is the first step to learning.** Csikszentmihályi referred to engagement as “flow,” and showed that full potential is more likely to be reached when people fully immerse themselves in an activity with single-minded, energized focus. Engaging sensory perception is one step in the path to deep learning. As students see, hear, feel, taste, and smell the elements of a lesson—through realia or through visualization exercises—they experience the lesson in a way that is not soon forgotten.

**A warm and welcoming emotional climate in the classroom** is key to the successful integration of the social-emotional brain function. Students need to have a safe place to embark on intellectual risks. All-too-many of our most gifted students have become invested in right answers to predictable tasks. As we embark on a path of intervention that both serves and creates giftedness, it is imperative that we create a responsive environment that builds on strengths and encourages intellectual struggle. Students should be self-reflective, and should play a big part in the prescriptive diagnostics when mistakes are made.

**Cognition is the third element of learning.** It is not third in importance, but neither is it paramount. When I begin work with any group of students (Kindergarten through University), I remind them of the 1957 classic, Bloom’s Taxonomy. We close our eyes and imagine walking through the desert, anticipating the moment when we open our eyes and see before us the pyramids at Giza. We notice that the foundations are substantial and strong, but it is the pinnacle that causes awe. The lesson translates to the classroom; knowledge and comprehension (foundational knowledge) are important, but they are simply the foundation for something spectacular to rise heavenward. If we stop with the knowledge that can be translated to standardized, multiple choice tests, it is as if we set the table and invite our students to a seven-course feast, but never get past the basket of bread.

If we stop with the knowledge that can be translated to standardized, multiple choice tests, it is as if we set the table and invite our students to a seven-course feast, but never get past the basket of bread.

**REFERENCES**


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Educating Science Critics, Connoisseurs and Creators
What Gifted Students Must Know about How Science Functions

By William F. McComas

There is little argument that a rich introduction to science is a worthy element of the educational experience for all students. Indeed, starting in the late nineteen century, the school curriculum has featured increasing numbers of science classes for K-12 learners with specialized classes including electives and advanced placement experiences for those with the highest levels of interest and ability. Of course, this expansion of the science curriculum is very good news but comes with a striking warning.

Much of the focus in science classes from the preK years through college does little to reveal to students how science functions. The vast majority of science learning goals feature traditional science content. The end result of scientific investigations is augmented by the learning of scattered science process skills, the tools of research scientists. The content that is generally missing from science instruction relates to a discussion of the ways and means by which knowledge is generated and validated, a domain commonly called the “nature of science” or NOS. Even though state science standards have an increasing number of targets related to NOS, few science classes and even fewer textbooks include much focus on what should be one of the most important instructional goals, the nature of the discipline itself. Without such a background, it is impossible for students to effectively contribute as a critic, connoisseur or creator of science—the three major ways in which any student might make use of his or her science knowledge.

First, let us consider “creator” as a rationale for the study of science as a career goal. This is certainly the most common reason provided for why we have our students study science in school. Students and teachers alike accept that one of the major reasons for studying science is that much of the knowledge transmitted may someday relate to an occupation in a science related field. In other words, students may, in the future become creators of
Much of the focus in science classes from the preK years through college does little to reveal to students how science functions.

new scientific knowledge themselves in research or engineering or at least, may use such knowledge in an allied science field such as medicine or technology. Unfortunately, if students make the decision that they will not pursue a career in the sciences they may too quickly conclude that there is no reason at all for them to worry about science learning. This faulty conclusion gives rise to another reason for the study of science, that of the connoisseur.

Connoisseurship is related to an avocational focus in a subject. I often ask my graduate students in science education to go to a bookstore with a large magazine section and examine the number of periodicals that focus on science-related subjects. The number of such works is surprising as are the number of handbooks on bird and plant identification and trade books on various elements of science for non-professionals. This exercise can be repeated at home by looking at the number of science themed television shows on air and the science museums and nature centers that attract countless individuals annually. It turns out that science is intrinsically interesting to many people, well beyond the population of those who use science in their daily jobs. Those who have some non-professional interest in science, its products and processes, are connoisseurs. How sad it would be if school science did not adequately prepare or whet the interest of such future science connoisseurs.

Finally, we come to the critic as a rationale for the teaching of science. Every school subject should enable students to carefully analyze and make judgments about that discipline. This is particularly true in science where our current students will be the consumers and voters of tomorrow. Almost daily one can see an advertisement for a product that makes scientific-sounding claims for its effectiveness or a news report of some health-related finding based on research and testing. We want our students to be able to critique such claims and render conclusions based on their knowledge of what counts as science and what is in reality pseudoscience or worse. There are aisles in any pharmacy featuring products that would likely not be for sale if only consumers could recognize the faulty claims for effectiveness made in their advertisements.

Consider, too, the issue of citizenship more broadly. Most everyone will be asked to vote on issues that have scientific foundations. We will all be asked to evaluate candidates’ claims and positions on science-related issues. Many of us may sit on juries where verdicts can only be rendered accurately by those who understand science, its methods, and its limitations. Students of all abilities may assume the roles of creator, critic and/or connoisseur of science as they take on their adult responsibilities, but gifted students are among the most likely to recognize and seize the opportunities that these roles offer.

No matter which role a student finds personally rewarding, each will require that the student gain an enhanced understanding of the nature of the discipline. Therefore, it is logical to consider what we should be teaching regarding that nature. Fortunately, science educators have been thinking about this issue for many years and are now converging on a proposed list of “nature of science” topics that should be included throughout the science curriculum. Such a list of NOS content will be considered next by focusing on nine NOS elements organized into three clusters related to science as a process, science as a human activity, and the questions addressed by science. The proposed elements within these three clusters are not definitive; there may be other NOS topics worthy of inclusion in the curriculum, but the conclusion among science educators is that topics such as these must be featured in science instruction if students are to understand how science works.

**SCIENCE AS A PROCESS**

**Science relies on empirical evidence.** One hallmark of science is that no matter who is offering a conclusion—scientist or amateur—there must be evidence to back up the claim. Furthermore, that evidence must be “sharable,” in that the fleeting glimpse of something interesting may be compelling but it can’t be conclusive until others have had a chance to see it and evaluate it. The various sightings of “Bigfoot” come to mind here. There may be some huge secretive humanoid wandering about the remote reaches of the planet, but there is simply no conclusive evidence for such a creature. We may wish that Bigfoot exists but wishing does not make it true. Students must understand both the necessity for and nature of scientific evidence if they are to appreciate how scientific claims are made and evaluated.

**There is no single step-wise scientific method.** A persuasive, but false, notion is that there is a six-step method by which work in science is conducted. Many teachers suggest that all scientists start their research endeavors by defining the problem, going to the library, formulating a hypothesis, designing an experiment, proposing a conclusion, and reporting results. This method does serve as a good model for how a problem may be tackled, but does not represent the way in which all science is done. Unfortunately, science educators who offered up such a research method in textbooks appearing in the mid-twentieth century are the source of this incorrect idea. Scientists themselves would be surprised to
hear that they all share such a common mode of investigation and would be fascinated to learn that students believe that scientists all conduct classic experiments.

A review of the work of researchers such as Jane Goodall, who fifty years ago began her detailed observations of the chimpanzees in western Tanzania, clearly disproves the notion of a step-by-step experimental method. Goodall’s science is just as rigorous—and just as empirical—as that of other scientists but without experiments. Of course scientists do share a number of tools that might be called methods including careful data collection and reasoning with both inductive and deductive means, but science cannot be reduced to any particular set of shared steps. In fact, the idiosyncratic ways in which scientists work result in a strong creative element in science that we will hear about in a subsequent section.

**Laws and theories are distinct kinds of scientific knowledge.** Another particularly pernicious idea is the supposed continuum from hypothesis to theory to law with laws being the pinnacle of scientific knowledge. This notion is reflected in the unfortunate expression—usually directed at evolution—that it is *only* a theory. “baby” theory) might best be called an explanatory hypothesis. A hypothesis that is designed to suggest a pattern or relationship (i.e. a “baby” law) should be labeled a generalizing hypothesis. Adding to the confusion is the fact that many teachers use the term hypothesis when referring to a prediction. In these cases, it would be best just to use the label “prediction.” There is so much potential confusion regarding the term hypothesis with its three distinct meanings that I have long wondered if we wouldn’t be better off without it.

Laws, theories and hypotheses are related, but they are most certainly not the same. Laws and theories, once they are supported with evidence and accepted by the scientific community are equally valuable and important kinds of scientific knowledge. Therefore, waiting for a theory to become a law is a fool’s game.

### Science as a Human Activity

**Science is a creative process.** In a study completed some years ago, researcher Sheila Tobias asked bright liberal art stu-

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**The idiosyncratic ways in which scientists work result in a strong creative element in science**

The clear implication is that something is worth believing when it is raised above theory status.

All of this is false despite the fact that this continuum is commonly taught in schools. This section could be book length in order to discuss all of the details it contains but perhaps if we stick with the definitions, this will make sense. Let us start with the definitions of law and theory before moving on to the problem with hypothesis. Laws are patterns or generalizations about something in nature and can be used to predict the appearance of another example of that pattern.

A *theory is the explanation for why a law operates as it does.*

For instance, if an air-filled balloon is put in a hot place it will expand—that’s the law. The kinetic molecular theory of matter suggests that air is composed of tiny particles that behave like billiard balls that become more active as temperature rises and push against each other causing expansion—that’s the theory. Even scientists fail to use the terms “law” and “theory” in the most accurate and appropriate fashion so it is always best not to worry about the label given by science—law or theory—and look at what the idea does rather than what it is called. Laws generalize and theories explain.

To turn quickly to the idea of the hypothesis we find the term used mostly to represent a trial idea. Many teachers define it as an educated guess. That’s fine, but an educated guess about what? A hypothesis that is designed to provide an explanation (i.e. a
can also be one of the most contentious. Although anyone of any culture can do science, the rules of the game of science are international. To say this in a different way, no matter what is contributed to the domain of science, it will be evaluated using the same criteria. The needs and priorities of various groups and nations do dictate what is worthy of study (and funding) but science is science. One does not win a Nobel Prize (or even add something to textbooks and journals) in categories of nation or culture but on the quality of the research.

Because of this, a potentially problematic issue in school science is that the vast majority of scientists studied are whites of European descent. One means for addressing this issue is to acknowledge it head on by describing the history of science and the rules of the game while using as many diverse examples as possible. Ultimately, the way to address this situation is to ensure that all students have the skills necessary to make scientific contributions thus writing a new history of science to inspire future learners.

THE QUESTIONS ADDRESSED BY SCIENCE

Scientific knowledge is durable, self-correcting, but ultimately tentative. The methods of science do ensure a high degree of validity and reliability in the conclusions offered at the end of a period of research. However, it is impossible to know that any particular law or theory will last for all time—particularly when new information and evidence are discovered in the future. Some have suggested that this inherent limitation of science means that we should hold no special reverence for scientific conclusions resulting in an “anything goes” view of the natural world, but that would be counterproductive. The conclusions of science have been tested and debated and, where necessary, updated and modified. Still, science is one of the most secure ways to know about the patterns in nature and the explanations of those patterns.

Science cannot answer all questions. A complete view of the nature of science includes the realization that the tools and methods of science cannot shed light on every question of human interest; there are limits to the questions that can be investigated using scientific means. Questions in morality, aesthetics, and faith fall outside the lens of science and are often the domain of philosophy and religion, two other institutions that mankind has looked to for guidance.

Of course, it is possible to determine what percentage of the population expresses a preference for a particular work of art or music, but it is unreasonable to expect that science could fully explain why such opinions exist. Likewise when humans want to know something of the afterlife, science cannot provide much guidance. Science, philosophy, and religion play vital, but distinct, roles in human affairs, and asking a question of the wrong authority has suggested that a war exists between these unique ways of knowing.

Science and technology impact each other but they are not the same. In the minds of many, science and technology are synonyms but it would be more accurate to consider them two sides of the same coin. Science is the pursuit of pure knowledge while technology represents the ways to solve a particular problem. Of course, these two pursuits interact frequently, but they are not the same. In the quest to explore nature (otherwise characterized as science) technology is frequently applied. As work proceeds toward the development of some useful product (often characterized as technology) scientific principles are frequently applied. Most scientists apply technology and many technologists apply science as they engage in their work. Occasionally, individuals work almost exclusively in one domain or the other.

Consider the case of Einstein and Edison. Edison was clearly a technologist. His statement, “ Anything that won't sell, I don't want to invent. Its sale is proof of utility, and utility is success,” is testament to the focus of his endeavors. In fact, had Edison applied scientific principles more regularly he might have invented the filament for the light bulb without having to go through one thousand trials of materials that were not useful in that regard. Contrasting Edison, we find Einstein who was not interested in products and, as a theoretical physicist, did few experiments (which might have made use of technology) to verify his predictions.

The distinction between science and technology is certainly not the most important in the nature of science but one that has interesting ramifications for research work in the modern world.

FINAL THOUGHTS

The nine elements of the nature of science discussed here should be the starting points for a more complete discussion of science in classrooms across the nation. It is not enough to tell students of the products and discoveries of science; we must assist students—particularly those of the highest abilities and interest—in achieving a complete understanding of the foundation of science itself. Science is a “game” that anyone can play but only if the shared rules are understood and followed. The nature of science, represented here by nine basic ideas, is a kind of handbook of those rules. When students appreciate the rules of science they will become better critics in evaluating the products of science, more passionate connoisseurs of science, and more effective creators as they apply science in the pursuit of new knowledge as practitioners of science.

Internet Resources concerning “nature of science” issues
http://casa.colorado.edu/~duncan/pseudoscience/
http://evolution.berkeley.edu/evosit/nature/index.shtml
http://lawrencehallofscience.org/seeds/PDFs/StrategyGuides/S6_Shoreline%20Scientist

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Math and Science and the Internet

Exploring Cogito, Smithsonian Institution, NOVA, and Cool Math

By Carolyn Kottmeyer

There are plenty of websites full of games and educational units in math and science on the Internet. But what is the advantage of using Internet resources over teaching math and science in the classroom? What do Internet math and science sites offer us that is different and unique, whether we’re comparing them to other Internet resources, or comparing them to real-life resources such as textbooks and classroom teachers? You may be surprised!

In a regular classroom the math-and-science gifted child may be unique, or one of a small set of kids interested in math and/or science at a high level. With the large variety of subjects within the general topics of math and science, the chances of meeting another child in a class of 25 or 30 students who shares the same specific passion are slim. More importantly, the gifted child needs mentors—adults and older students—who share this passion and will share time and information with the gifted child. Unfortunately, if the child is from a low-income school, teachers have far more basic education concerns than meeting the advanced math and science cravings of the gifted child.

If the gifted child is lucky, he or she may encounter a single teacher in high school who shares the same passion for a specific area of math or science and is willing to work with him or her. But our math and science gifted kids crave this connection before a chance encounter with a single teacher during their last year or two of high school.

In TechCrunch’s “Bill Gates: In Five Years The Best Education Will Come From The Web,” techcrunch.com/2010/08/06/bill-gates-education, Gates talks about colleges becoming a more virtual and less costly alternative for a better education in the near future. But it’s not just college students who will have access to these resources; our gifted kids will be able to access electronic courses as soon as they are ready for them. They won’t have to wait for the appropriate chronological age and a high school graduation certificate before they can expand their education electronically.
Our math and science gifted students need access to peers, to mentors, and to resources and courses to build their passion and continue their math and science education both deeper and faster.

Our math and science gifted students need access to peers, to mentors, and to resources and courses to build their passion and continue their math and science education both deeper and faster. And for most students, this access is simply not available in the local brick-and-mortar school building. That’s where the Internet comes in!

COGITO

Let’s begin with a visit to Cogito, cogito.org, “Connecting Young Thinkers Around the World.” Created by Johns Hopkins University Center for Talented Youth and its partners, Cogito offers unique resources for our gifted math and science kids. Starting with the name, Cogito, we begin to understand the site. Cogito ergo sum is the Latin translation of the French mathematician and scientist Rene Descartes’ famous “Je pense, donc je suis,” or “I think therefore I am.” Cogito is definitely a resource for the thinking child. But Cogito is not a one-way street like most other websites, nor an “open season” like most other networking sites.

Cogito’s most recent addition is its page on the “Chemical Sciences.” While there have always been chemistry articles and people on Cogito, this new focus page offers a starting point for the student interested in chemical sciences. Start here to talk about chemistry with other students and experts in the “Chemistry Forum,” or to participate in special events like this month’s talk with Aman Malik, chemical engineering undergraduate student, and his Global Challenge teammates, about carbon sponges.

Read Cogito “Research & the Earth Snapshots,” sharing the perspectives of professionals. In this series, Cogito asked different researchers, some who research the Earth and some who just conduct research on it, the same three questions about how their work affects our planet and the environment:

- What does it mean to be green in your field?
- How does your work affect the environment, and how do environmental issues such as climate change affect the way you do your work?
- What do you do as a citizen to help protect the environment?

Check out Cogito’s great links in “Chem Sci Around Us,” including The Periodic Table of Videos, Green Research Projects by Young Scientists, and Test Tube: Behind the scenes in the world of science. Cogito brings you the best math and science links, in addition to all their other resources.

Visit Cogito’s other article links to learn about the possibilities in the chemical sciences. Chemists create low fat fried foods, chemists teach chemistry, chemists work in the Chemistry Olympiad, and chemists discuss which element is the most important. And as articles are added to Cogito that include chemistry, the ultimate cross-disciplinary subject, they are linked here on the “Chem Sci Focus” page.

Chemistry isn’t your thing? No problem! Chemistry is only one of over 13 different “channels” on Cogito, each in a different area of math or science. There is also a separate channel for younger students and another channel for content about being a gifted student.

What else can Cogito offer gifted math or science students? Lots! Check out the “Sites & Tools” section for courseware and free Internet courses in math and sciences. Find Carnegie Mellon’s tutorial on Building Virtual Worlds, University of London’s online Cryptography course, U.C. Berkeley’s Psych 156: Human Emotion, or Cold Spring Harbor Lab’s public portal to their video lecture series on DNA. The variety of free resources available is amazing, and Cogito keeps on top of new offerings in math and science, to keep our gifted students happy and learning.

Also in “Sites & Tools,” find the best news sources, blogs, and podcasts in math and science. You’ll even find fun stuff—games and activities online that math and science gifted kids love to explore!

Gifted kids love to hear from people actually in the fields they hope to go into, and that’s where Cogito Conversations come in. These conversations include weekly interviews with some of the world’s most famous mathematicians and scientists, as well as conversations with young people already involved in math and science at a professional level. Read interviews with the creators of the WorldMapper project, with Kiran Kedlaya, Mathematician and Puzzler, “Gamer Heaven: Report from a Gaming Convention,” or with professional science writers. Science and math careers aren’t just about doing the science and math, but also writing about it! Better still, suggest an interview to Cogito. Who would you like to hear from? Would you be willing to speak with the Cogito community? Cogito is always looking for its next conversation!

Cogito conversations aren’t all one-sided. Some Conversations are short-term dialogues where Cogito members can ask the questions, and guest speakers will reply. Interaction with experts is one of the valuable and unique components of Cogito.

Cogito “News & Views” offers a world-wide summary of science...
and math news, focusing especially on young scientists around the world. With over 200 young scientist news items so far, there’s sure to be something to appeal to every young math and science student. And these college, high school, and even middle school young scientists can become role models for Cogito members!

News & Views also includes news on the movies; find math- or science-oriented movies that you are sure to enjoy. Or visit “Humor,” and find funny, witty and sometimes sarcastic articles, the registration process; this includes an online parental permission form for students 13-18 years old, and a physical permission form for students under age 13.

All Cogito members must follow Cogito “House Rules”, keeping the community safe for all. Member privacy is protected through the use of pseudonyms and personal avatars. Members who have turned 18 are not excluded; instead they gain a profile indication that they are over 18. Older members are encouraged

While Cogito’s community approach is unique, there are many other ways gifted math and science students of all ages can use the Internet to support their passions in Mathematics and Sciences.

math and science cartoons, and more. The Essays section includes essays, writings and even graduation addresses that offer scientific or mathematical insight into the world as our kids may experience it.

On Cogito, you can also find lists of real life resources that interest math and science students. Contests in mathematical and scientific areas, summer programs and internships are listed, along with regional activities available only to Cogito members.

Forums are one of the most valuable and unique features of Cogito. Here students can find a community of like-minded math and science students to talk with; accomplished expert mathematicians and scientists to interact with; and always something new and different to learn, to discuss, and to share. Members can share with other members in forums on a wide variety of science and math topics, in addition to the more general topics of puzzles and brain teasers, competitions, and school, college and career forums. Special topics forums at this time include “Learning Engineering Online,” “Stargazing and Star Parties,” “Health Care Debate Revived!” and “Is Extremely High Intelligence Worth It?” These forums can change as the members of Cogito propose new topics to the moderation team!

While most of the resources of Cogito are available to the general public, all the areas that involve student discussion and interaction require membership in Cogito. If students are participants in Johns Hopkins Center for Talented Youth (JHU/CTY) programs, cty.jhu.edu or other partner organizations’ activities, they should have already received an invitation to join Cogito. If students have lost their invitations, they can contact Cogito to have their invitations reissued. Cogito members can also recommend their like-minded friends to become Cogito members; just write to Cogito and introduce your friend.

If students or their friends are not involved in one of the JHU/CTY or partner organizations, they can still join Cogito through

SMITHSONIAN INSTITUTION VIRTUAL MUSEUMS

For students who cannot travel to amazing museum exhibits, the Internet is a great way to gain access to these valuable resources from home or school. The Smithsonian Institution, si.edu/exhibitions, offers a wide variety of online exhibitions. My favorite part of any Smithsonian visit is the National Gem and Mineral Collection and apparently I am not alone! The Smithsonian online exhibitions include the National Gem and Mineral Collection, part of the Dynamic Earth exhibition, mh.si.edu/earth. With the multimedia exhibitions of Gems and Minerals, Plate Tectonics and Volcanoes, Solar System, and Rocks and Mining, The Dynamic Earth offers a great introduction to the world around us here on earth and beyond.

And the Dynamic Earth exhibition is just one of dozens of online exhibitions from the various Smithsonian Institution museums. But the Smithsonian doesn’t stop at online exhibitions. They now offer an Android and iPhone app, just for you, MEanderthal, humanorigins.si.edu/resources/multimedia/mobile-apps. Do you look like your relatives? Or like your prehistoric ancestors? Download this cute app for your Android from the Android Marketplace, or for your iPhone from iTunes, and see how you morph into your ancient ancestors! Part of the Smithsonian Human Origins exhibition, MEanderthal gives you an up-close-and-personal look at how you fit into your own ancestry!

Like the Smithsonian itself, the Smithsonian Institution, si.edu/
A web resource, is a vast resource, with something new to discover every time you visit. What interests you today?

**NOVA**

Another Internet resource for all subjects and all ages is the NOVA section of the PBS website, [pbs.org/wgbh/nova](http://pbs.org/wgbh/nova). The advantage of many of the NOVA collections over other Internet resources is their complimentary teacher materials. And many NOVA topics also include online interactive instruction and activities. But you must visit NOVA for yourself; any printed description will not do justice to the variety of resources found in this unique collection.

Use NOVA to investigate hundreds of topics in science, divided into topic areas: Body & Brain, Evolution, Nature, and Planet Earth. Watch a NOVA episode titled “Lord of the Ants” to learn all about how these tiny creatures inspired naturalist Edward O. Wilson to arrive at some rather large conclusions. Then read an interview with Wilson about his theories on biophilia, which he defines as “humans’ innate tendency to focus on living things, as opposed to the inanimate.” Is biophilia important in today’s world? What may happen if we fail to cultivate biophilia in the future?

Visit NOVA to explore Fractals, [pbs.org/wgbh/nova/physics/fractal-generator.html](http://pbs.org/wgbh/nova/physics/fractal-generator.html). The interactive Fractal generator is fun, and allows you to see exactly how a fractal is created. But that’s only the beginning. Learn the details of the creation of a fractal from the original Mandelbrot set. Find fractals in nature, and read an interview with Mandelbrot himself. Dive into a fractal to a magnification of 250,000,000x… what will you find?

What you’ll find is certainly not the stuff of middle or high school mathematics, but it is the kind of mathematics that excites and inspires gifted math students to dig deeper into mathematics, to see what they can discover! This is just one of dozens of topics explored in depth in only one NOVA area, Math and Physics. You’ll also find dozens more topics in Tech & Engineering and Space & Flight.

And if you have students who aren’t really math and science kids, NOVA is there for you, too! Visit and explore Ancient Worlds and Military & Espionage. NOVA makes science available to us all—especially to our gifted youth—in ways they can only dream of in a high school biology or chemistry classroom.

**COOL MATH**

For mathematics, visit Cool Math, [www.coolmath.com](http://www.coolmath.com). Cool Math, and its sister site Cool Math 4 Kids, [www.coolmath-4kids.com](http://www.coolmath-4kids.com). They offer an amazing variety of free interactive mathematics activities for our kids of all ages.

For kids as young as ages 3–5, Cool Math 4 Kids offers games and fun to instill and reinforce not only a strong arithmetic background, but a love for math that will grow with the child. There are quizzes to reinforce math facts of all kinds, from addition and subtraction through multiplication and division, and then moving on to decimals, lattice multiplication, and other math topics our kids will encounter in math classes. When the practice is done, stick around for the fun. Cool Math 4 Kids explores simple tessellations, fractals and polyhedra; offers fun jigsaw puzzles and brain benders; and has cool interactive demonstrations like Space Flight… careful, this one can make you dizzy!

Cool Math 4 Kids has activities for gifted kids from basic arithmetic until they’re ready for pre-algebra… and then Cool Math takes over! Labeled appropriate for “ages 13-100,” Cool Math offers lessons in pre-algebra, algebra, geometry, pre-calculus and calculus. For parents and teachers, don’t miss the Teacher’s Success Areas, with hints, resources, and links to other sites designed to help guide our students to math success.

If you don’t consider yourself a “math person,” read *My journey from nauseous mathphobe to the creator of Coolmath.com*, the first part of the Math Survival Guide: Heal the Past, Conquer Anxiety and Build Success, coolmath.com/math-anxiety-survival-guide. Written for your less math-minded student, this once-published, now-free-online book offers great advice in a fun narrative. “But, I warn you, in this seemingly innocent math book, there is talk of spiders, spit, and a booger that meets with a terrible fate.”

The rest of Cool Math is just as much fun. In addition to the Lessons and Dictionary, there’s a Geometry/Trig Reference, Math Practice, and tons of fun Math Games. Need to practice your geometry, or your parallel parking for your driver’s test? Try Parking Mania 2! coolmath-games.com/0-parking-mania-2. Use the arrows to control your car, but watch out for oncoming traffic, and don’t go in too fast! Level 1 is easy enough, but keep going… like parking on downtown streets in rush hour traffic, nothing is as easy as it seems at first!

And for those kids considering their own small business, play Lemonade Stand, coolmath-games.com/lemonade, or Coffee Shop, coolmath-games.com/0-coffee-shop. In Lemonade Stand, learn that lemons don’t grow on trees, and sugar is sweet… especially to ants, as you battle the weather to sell the most Lemonade. The Coffee Shop is similar, but reputation comes into play so be certain you are consistent in your product!

And these are only a few of the cool math games you’ll find at Cool Math!

Inside the classroom, Internet math and science resources can be used for math and science talented students to explore new areas and dive deeper into school math and science while the other kids are receiving the classroom instruction they need. Inside or outside the classroom, these resources can be used to find peers and mentors for our gifted children, as well as amazing, exciting, and interactive curriculum to extend and enrich any classroom topic—all free. Math and science come alive on the Internet!
Enhancing Your Child’s Education with Math Circles

By Craig Daniels

A math circle is a group of kids and a teacher with the teacher having a different role than they have in most classrooms. In a math circle, the teacher poses questions for the students, stands back, and, as Bob Kaplan says, lets “congenial conversation take over,” www.themathcircle.org. The goal is to have the kids take charge of the discovery of the answer.

The basic process for a math circle is:

1. The teacher poses an interesting question that, when and as it is answered, teaches the kids something important about math.
2. The teacher then guides the kids by asking questions so that the kids learn that they need to solve it, that the teacher is not going to solve it for them.
3. Along the way, the teacher helps them learn how to hold that congenial conversation—to speak up as they get an idea but not step on each other’s ideas.

Who are math circle kids? They are kids who want to be there to learn about math. If a child doesn’t want to be there, but the parent wants them there, it won’t work, and that will affect the whole group. These kids are nicely asked to come back when they are ready.

Who are the teachers? They are people who know the subject they are teaching and the connecting curriculum areas because eager and curious kids will certainly bump up to the “borders” of the subject. It is also possible that the kids will head to an area that wasn’t part of the original question and if the kids are enthusiastic, the teacher might want to let them pursue that. And, at least as important as the math knowledge, the teachers need to like children.

Back to the “congenial conversation”: math circles are about more than math. They are also about the art of conversation. The kids don’t need to raise their hands and need to unlearn some habits and learn some new ones. The process could be the following:

call on them if they raise their hands, but let them know they don’t need to. Remind them of this until they stop raising their hands. If, after they learn that, they get so excited they interrupt each other, then remind them that they don’t need to raise their hands as long as they don’t interrupt.

As an example of a math circle topic, let’s look at kindergartners working on the question, “Are there numbers between numbers?” As they work on the question they will create a number line, perhaps starting at zero, or perhaps at one, and have a few other numbers on it. Once everyone is comfortable with that, fractions are added to the number line. To help the children get at the initial concept of fractions the leader might ask, “How old are you?” Most likely at least one kid will be five and a half. The teacher would respond, “Oh, and a half, where should we put that?” Over a series of sessions, the kids will find other fractions, place them in the wrong places, and eventually move them to the right places.

An example with older children would be High School students working on the possibility of whole number solutions to the Pythagorean theorem. (The Pythagorean theorem states that for right triangles, the sum of the squares of the shorter sides equals the square of the longest side.) Assume that at least one of the students would know about a 3, 4, 5 right triangle ($3^2 + 4^2 = 5^2$). The math circle teacher would help guide them through questions to other whole number solutions. They would discover that there are also multiples of 3, 4, 5 right triangles that work (6, 8, 10 for example). Eventually the question will be asked—either by the leader, or ideally, by one of the students, “Are there any other triples that are not multiples?” (5, 12, 13 for example). Searching for the solutions builds their problem solving skills, their intuition about numbers, their pattern identification skills, and their multiplication skills. Later other questions can be asked such as, “Is there an infinite number of base cases?” (a base case being 3, 4, 5 or 5, 12, 13 – not a multiple such as 6, 8, 10). They will also want to know if there is a way to generate them,
Imagine being able to prove or derive the Pythagorean theorem rather than just being told it is true and memorizing the equation.

Students who participate in math circles should gain or experience some, or all of the following:

- enjoyment of math
- ability to take charge of getting an answer to a problem
- vital knowledge that hard problems can be frustrating but if one keeps working on them, they can usually be solved
- discovery that math will give them an understanding they didn’t have before

Imagine being able to prove or derive the Pythagorean theorem rather than just being told it is true and memorizing the equation. Of course, not all math circle sessions do all of that each time, but over time, much or all of that should be accomplished.

There is more than one type of math circle being taught in the United States. To over generalize, let’s say there are two types although really there is a continuum of them so there are flavors between those two. I’ve given examples of one type of math circle. The other type is more focused on competitions, such as the Math Olympiad. I can’t speak to that type as well but I believe that there are more problems given per session and more problem-solving techniques are discussed. There is a little more talking by the teacher and the focus includes competition.

If you are interested in having your child in a math circle, find a circle near you, but also find out what its philosophy is. If you try it, be sensitive to whether it fits your child, or children, or not.

Here is a good web site to help you find a circle near you: [http://www.mathcircles.org/Wiki_ExistingMathCirclePrograms](http://www.mathcircles.org/Wiki_ExistingMathCirclePrograms).

**CRAIG DANIELS** is a self-employed Information Technology (IT) consultant and math enthusiast who lives in Portland, OR with his two gifted daughters. In the past he has helped his kids’ teachers with math pull-out groups. This last school year he was on Portland Public Schools’ (PPS) K-5 Math Curriculum Adoption Committee and was Chair of PPS’s parent Talented and Gifted Advisory Council. He has been trained to facilitate Math Circles by Bob and Ellen Kaplan at their Math Circle Institute and by the Mathematical Sciences Research Institute.

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**Find Resources on the CAG Web Page at:** [cagifted.org](http://cagifted.org)

- **Position Papers on the following topics:**
  1. Acceleration
  2. Intellectual Peer Interaction
  3. Gifted Learners in the Regular Classroom
  4. University and District Sponsored Certificate Programs
  5. Highly and Profoundly Gifted Children
  6. Grouping Practices for Gifted Learners
  7. Gifted Children at Risk, Academically and Intellectually
  8. Academic Programs and Services for Gifted Learners
  9. Homeschooling the Gifted Learner
  10. Teacher Qualifications
  11. Social and Emotional Needs of Gifted Children
  12. Identification of Gifted and Talented Learners
  13. Characteristics of Gifted Children
  14. Infancy and Early Childhood
  15. Early Learning, K-3
  16. Twice-Exceptional Gifted Students
  17. Underrepresentation
  18. High School Programs

- A download of the Recommended Standards for Gifted and Talented Education Programs, from the California Department of Education adopted by the State Board of Education in October, 2001 and revised July 2005. It includes the components of:
  1. Program Design
  2. Identification
  3. Curriculum and Instruction
  4. Social and Emotional Development
  5. Professional Development
  6. Parent & Community Involvement
  7. Program Assessment
  8. Budgets

- A CAG annotated bibliography of recommended books and journals
- A CAG resource listing of gifted education associations, journals, organizations, research centers, and summer programs
- A CAG glossary of terms related to educating gifted learners

Find them at: cagifted.org.
The need for math skills in our lives in the twenty-first century is increasing. The National Council of Teachers of Math (NCTM) has articulated this need explicitly in the introduction to the math standards document.

We live in a mathematical world. Whenever we decide on a purchase, choose an insurance or health plan, or use a spreadsheet, we rely on mathematical understanding. The World Wide Web, CD-ROMs, and other media disseminate vast quantities of quantitative information. The level of mathematical thinking and problem solving needed in the workplace has increased dramatically. (NCTM Standards, 2000)

For those of us who teach gifted children, it is no surprise that some of our students are gifted in math and some are not. Some of our students have a passion for math and some do not. However, they all possess the intelligence to do math if they are motivated, even the students who moan and say, “I hate math. I don’t get it.” So, how do we reach those students? How do we motivate them to see that whatever their previous experiences with math, math is not an enemy? How can we help them recognize that their attitude toward math is an obstacle to their understanding and success? How do we facilitate them in changing their attitude toward math?

Somewhere along the way in my twenty-five year journey as a teacher of the gifted, I realized that when students realize that math is indeed everywhere and relevant, then their attitude shifts and their personal investment in learning math truly starts. We can then demonstrate to them that there are strategies they can learn and apply that will make them more successful in math. As a teacher, the big question remains: How can we shift the attitude about math of our mathematically under-achieving students from negative to positive in order to help them become more open to studying and learning math?

When I initially began to think about this question in the mid-1980s, there was very little professional literature in gifted education or children’s literature containing stories, poetry, or nonfiction that dealt with the issue of attitude shifting either directly or indirectly. I thought about my own path with math over the years as a student and a teacher. I don’t hate it anymore. As an adult, I actually came to like it. How had that come about? There was a major influence that brought about that change. I finally saw the relevance and connection of math to the real world. Through sheer necessity I expanded my own real-world math awareness. Could I devise lessons that would expand real-world math awareness for my gifted students who had a negative attitude about math?

Grounded in my own experiences with math, I set to work. I have continued to devise, revise, and implement strategies and activities to enhance students’ real world math awareness right up to the present. Since I began this work, children’s literature designed to enhance students’ understanding that math is everywhere has come into being. Over the years, I have come to believe that we guide our students to make this attitude shift about math from negative to positive through helping them to see the connections of math to the real world.

In my math classes of gifted eight and nine year olds, I always
have some students whose gifts are mathematical; but I also have
students whose gifts lie in other areas such as language or mu-
sic or visual arts or communication skills with others or dramat-
ic art. I have seen a great deal of diversity in the interests and
strengths of gifted students. From these observations, I have ob-
served repeatedly that when a gifted child is interested in a sub-
ject, that child will pursue knowledge of that topic like a hungry
caterpillar, consuming, digesting, processing, until the subject or
topic is owned by that child. Interest leads to engagement with a
topic and paradoxically, engagement leads to interest in a topic
being heightened.

Gifted children are highly curious and observant. Knowing this,
I begin to awaken their real world math awareness by first posing
a question: “Where in the world do you find math outside of this
classroom?” The notion that math exists outside the classroom is
sometimes a shock to the child who has up to that moment only
viewed math as a curse that comes with school. In my opinion, it
is the experience of learning to see that math is everywhere that
begins the attitude shift that results in students becoming open
to seeing the relevance of math in their every day lives and thus
increasing both their interest and their engagement with math.
After asking the initial question, we brainstorm together and I list
the initial responses from my students on the board. They head
up a page in their math journals entitled “Math Is Everywhere.”
Following this initial five minute class brainstorming session, I
read aloud to them Math Curse (1995) by Jon Scieszka and Lane
Smith. When I finish reading this marvelous picture book aloud
to them, I have them work in partners and see what they can add
to our initial “Math Is Everywhere” list. We then share back as
a class and add anything new that comes up to our class list of
“Math Is Everywhere.” They record the additions in their math
journals. As homework, I challenge them to prove to themselves
that math is everywhere by noticing the math they come across
outside the classroom, remember it, and then share with the class
a story about what they noticed and where it was. Each day for
the next few days at the beginning of class, I ask if anyone has
a story to share about math in the real world. This story sharing
activity takes 5-10 minutes—no more—and continues to build
the students’ real world math awareness in a non-threatening way,
story-by-story.

There are countless activities that one can devise for students
using the foundation laid through this initial awakening of real
world math awareness. You are limited only by your own imagina-
tion, applied creativity, and real world math awareness. Here are
some examples of such activities.

A unit of measurement. If you are working on a unit in mea-


curement, children can bring in packaging that shows both metric
and standard measurement on the packaging. I like to use food
packaging that has been washed, because when we are done, we
recycle it. You can model math story problem questions based on
such packaging and then have the children work in partners to
create and solve story problems. You can adjust the focus of the
math problems according to where you are in your curriculum.
For example, you might require that they use two steps to solve
their problem; or that the problem must use both addition and
subtraction to solve; or use three or more addends. In defining the
parameters of the problem, you are also highlighting the language of
math.

Highlighting the use of money. Collect menus from local res-


taurants. Many restaurants have take-out menus they will give you
for free, and some restaurants will give you regular menus for free
if you explain that you are a teacher and want to use the menus
in your math class. Divide the class into groups and have them
act out a scene of going to a restaurant; assign rotating roles of
customers and table waiters. I recommend 3 or 4 to a group. Do
the exercise enough times so that everyone has the opportunity
to be a customer and a table waiter at least once. The orders writ-
ten down by the table waiters are saved and these form the raw
data obtained from the menus to start working on the group story
problem. Students work collaboratively to compose and solve the
problem. Again, you set the parameters of the problem according
to your curriculum.

Integrating art and geometry. Provide your students with im-
ages of art through the Internet or postcards from art collections
or posters or calendars (a relatively inexpensive way to build a
collection for classroom use). I prefer to use nonrepresentational
paintings such as those by Kandinsky to begin, because the con-
nection between math and art is so clear in many of his paintings.
Do a mini-lesson with one of these images where students help
find the geometric forms within the painting. Then, have students
work in pairs with a different image to do the same activity. This
exploration can be followed up by passing out graph paper or us-
ing graph paper in their journals, to design an image using geo-
metric figures as the basis for that image. These are three examples
of bringing real world math into your math class.

Increasing the real-world math awareness of your students is
beneficial for all students. It increases the interest and engage-
ment for the under achieving math students, but it also fires the imag-
nation of those students who are already passionate and positive
about math. It is a win-win for all. Have fun, look around, and see math
everywhere! ■

REFERENCES
National Council of Teachers of Mathematics website www. nctm.org [Source for copies
of the standards by grade level]
Web Museum, Paris www.ibiblio.org/wnm/ [Source for artistic images]

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Teaching Your Students About Their Brains

By Barbara Clark

As early as the 1960s researchers were making breakthroughs in understanding the brain and how it functions. They discovered that the environment in which we learn, the experiences we have, and the variety of those experiences all powerfully affect our ability to learn and to remember what we have been taught. The following information can be used as a script for teaching your students about their brains. The language used may need to be modified to communicate with your students at their level of conceptual development. The activities suggested will help your students understand how their brain is organized, how it functions and how they can become better at developing their intellectual abilities.

Who are you?

To the students: With a relatively small number of exceptions, every human being comes equipped with a marvelous, powerful brain organized in a genetic pattern that only one person will have. Your genes are inherited elements that transmit the unique code of your inheritance of forms and structures to your cells. While your genes are inherited from your family, the specific pattern of your genes is unique to you. No one else has the same pattern of genes or potential that you have.

You are not born with all of your intelligence and abilities already developed. While you are young your brain is constantly changing depending on how you use it and how much you use it. As your brain grows, it creates more cells and each cell develops more connections with other cells. The more connections we develop the better we can think. We can solve problems more easily; we can do more difficult and amazing things. We can imagine more, discover more, invent more, and make our world an even more exciting place. How do we do this? Let’s find out!

The Neuron, the basic unit of the brain

Our brain is made up of tiny structures or cells that are called neurons. The billions of neurons within the brain are so small that 100,000 of them could fit on the head of a pin. The neuron is a tiny system for information processing that receives and sends thousands of signals. Inside the cell body of the neuron are the biochemical processes that maintain the life of the cell.

A neuron is made up of a cell body, many, many dendrites that branch off of the cell body, and an axon that carries messages from one cell to another (See Figure 2, p. 27). By holding up one hand with your fingers extended you have a very good model of a neuron (See Figure 3, p. 27). The extended fingers are located in the appropriate place for the dendrites and would more closely resemble dendrites if branches grew from each finger. The palm of your hand is the cell body. The arm extending below the hand makes a good model of the axon that, in fact, extends from the cell body in much the same way. At birth the human brain contains some 100 billion to 200 billion neurons. Each neuron is ready to be used to develop our mental and physical abilities to the highest levels of our potential.

No two cells are exactly alike or are any two brains alike. We are as different from one another as snowflakes, although, overall...
we function with the same processes. The dendrites are the pathways for receiving information from nearby nerve cells. They have short fibers that branch out from the cell body. The axon is a long nerve fiber that extends from the cell body, often branching at the end, to serve as a transmitter. It sends signals that are picked up by the branches of the neighboring dendrites. The activity between neurons is carried out by the axon of one cell contacting the dendrite of another. The end of the axon does not actually touch the dendrite of the other cell but transmits the information chemically across a region where the cells are particularly close. This junction across which impulses travel from one nerve cell to another is called the synapse. The transmission of a nerve impulse is an electrical-biochemical-electrical process. At the synapse, the electrical impulses that travel through the cell convert into biochemical signals and then are converted back to electrical impulses by the receiving cell. It is this synaptic activity that is thought to be the site for the nerve cell’s mechanism of learning and memory. Here is the seat of intelligence.

**GLIAL CELLS**

Surrounding the neurons are special cells known as glial cells. These cells outnumber the neural cells 10 to 1 and can be increased by stimulation from the environment. The glial cells provide the brain with nourishment, consume waste products, and serve as packing material gluing the brain together. They also insulate the nerve cell, creating a myelin sheath around the axon (Figure 2). Myelin is a special coating that protects the axon and amplifies the signal leaving the cell. Myelin has an important function; it allows the myelin coated axon to conduct information away from the neuron at a much faster rate than would be possible for axons less well myelinated. It is like the difference in electrical conduction through insulated and non-insulated wiring. The speed and power of the charge are increased by the presence of the insulation. As the glial cells in the brain increase and provide more myelination, the speed of thinking and learning accelerates.

**To The Teacher:** The rate of glial cell production is influenced by the richness of the experiences provided in the environment. The more glia, the more accelerated the synaptic activity will be and the more powerful will be the impulse exchange from one cell to the next. This allows for faster and more complex patterns of thinking, two characteristics we find in gifted children. The speed of thought can be amazing. If a nerve pathway is used often, the threshold of the synapse falls, so that the pathway operates even more readily. A wave front is started that may sweep over at least 100,000 neurons a second.

Another way to increase synaptic activity, thereby increasing the effectiveness and efficiency of the brain system, is to strengthen the neuron’s cell body. Although the quantity of neural cells may not be readily increased, the quality of the cells can be. This quality enhancement allows for information to be processed more quickly and for more power to be conducted, resulting in the availability of more complex neural networks, in essence, the creation of a better learner.

- An individual’s interaction in an enriched environment changes the chemical structure of the nerve cell, thereby strengthening the cell body. The result is more rapid, more complex thought processing.
- Using integration of ways to learn in the learning experience (e.g., using both physical and cognitive activities) increases learning and retention.
- Use of constant feedback, and learning in a rich environment are the additional keys to powerful learning and memory.

Nobel winning neuroscientist Gerald Edelman (2004) supports the importance of a variety of experiences and the essential nature of feedback as necessary to high levels of brain function. By providing quantity and quality of experiences we build memory, a basic component of the process of intelligence. With broadened memory comes accuracy of prediction, the basis of intelligence. This is an important reminder for the classroom.

**THE ORGANIZATION AND FUNCTIONS OF THE BRAIN**

**To the Student:** The functions of the human brain can be organized into four major areas (See Figure 4) each with different structures and chemistry. The idea that different areas of the brain...
are specialized for different purposes is central to modern brain science. By the use of these general areas we will be able to learn about major brain functions and their approximate locations. In reality, information is processed from many, many areas of your brain. Through pathways of nerve cells and linkages with nerve cells too numerous to count, input is analyzed by our brain and integrated in structures of cells at higher and higher levels. The result is retention and storage of unbelievable amounts of information. All of these structures and processes contribute to your uniqueness and to your view of the world.

**To the Teacher:** What we already understand about brain function requires that we who work with children, both parents and teachers, change our beliefs and procedures for optimizing teaching and learning. While the complexity of this total system is beyond the scope of our need for understanding, it is important to become knowledgeable about some basic structures and functions if our students are to have the advantage of developing their talents and abilities more fully. What we now know presents some exciting possibilities for improving teaching and learning. As additional information regarding the functioning of the brain becomes available, educators at home and at school can expect even more amazing benefits for enriching and enhancing their ability to create effective learning opportunities. (Reminder: Please adjust the following discussion of information to the age and ability of your students.)

**To the Students:** Again, as an aid to understanding the organization and structure of the brain, we can create structures with our hands that represent additional parts of the brain. Make a fist with each of your hands so that you can see your fingernails and then place your hands together with your fingernails touching. Your hands now form a very respectable model of the brain (See Figure 5).

With your thumbs facing you, wiggle your little fingers. This is the occipital lobe, the area through which vision enters your brain. Move your middle finger and you have located the motor area in your brain, an area called the parietal lobe. The area where you produce language is just below the middle knuckle on your right hand, which now represents the left hemisphere of your brain.

**To the Teacher:** Please explain to the students that the left hemisphere (their left hand) through the corpus callosum represented by their touching fingernails. This connector between the right and left hemispheres of the brain has within it more neural connections than there are in any other part of the body. Although each of the two hemispheres, perform differently—the left being most responsible for linear, logical function and the right for spatial, gestalt function—clearly, the interconnection or integration of the specializations of the right and left hemispheres is biologically intended. Our genetics and our gender influence the amount and expression of ability we have available in each of these areas of function, but the students should know that how much we use each function, both separately and in an integrated way, will determine how much ability we can develop.

**To the Student:** Now separate your hands keeping your fists closed and we can explore the inside of our brain model. Look first at your forearm-wrist area. This area represents the brain stem in which we find the location of our autonomic (i.e., automatic) function. Located here is the most primitive brain, the system that relieves us of consciously processing each breath and each beat of our heart. However, scientists working in the area of biofeedback have shown us that while most autonomic functions remain automatic, we can, if we choose, bring the awareness of these functions to consciousness, allowing us to monitor or change the process if it has become destructive or inefficient. For example, people with high blood pressure can use biofeedback techniques to monitor and change an inappropriate rate of blood distribution, consciously helping the body to better regulate this usually automatic function.

Also in the brain stem, we find the neural pathways for many higher brain centers. At the very base of the brain, just above the wrist in our hand model, is the cerebellum, a part of the brain that is involved with our motor control, coordination, and balance. Also located in this area is the reticular formation. It is the physical basis for consciousness and plays a major role in keeping us awake and alert.

Our brains have four basic areas of function: physical, emotional/social, cognitive, and intuitive. While the brain is very complex and never uses just one area of function at a time, we can better understand the brain by considering each of its four basic areas of function separately.
The Physical Functions

To the Students: The areas of the brain that process our physical functions are involved in movement and the use of sight, hearing, smell, taste, and touch. The access to our world is primarily through movement and physical sensing. Our level of intellectual ability, even our view of reality, will depend on how our brain organizes and processes this information.

To the Teacher: We know that gifted learners have a heightened ability to become aware of information from their environment and process this information in ways that expand their view of reality. They do, however, often define themselves by their cognitive ability and may believe that their value comes through that ability alone. Therefore, gifted students may focus more of their energy toward the pursuit of cognitive excellence and may even ignore their physical growth and development. Although many gifted children develop above-average physical skills, they, too, often value their physical pursuits far less than their cognitive endeavors denying the need for the integration of the body and the mind. It is not uncommon for gifted learners to develop a mental separation between the functions of the mind and the body (i.e., a Cartesian split). If unrecognized and allowed to intensify, such a mind/body separation can limit the cognitive growth they so value. Integration of the body and the mind becomes an essential part of a program for optimizing learning.

The Affective Function (Emotional and Social)

To the Students: The Affective Function is expressed in emotions and interactions among people and things that one cares about. This function affects and is affected by every part of your brain/mind system, but is primarily regulated from the limbic area by biochemical mechanisms housed there. The limbic area is wrapped around the top of the brain stem deep in the midbrain area, and includes the hippocampus and the amygdala (see Figure 1, p. 26). It is known as the emotional mind.

The limbic area contributes significantly to the learning process. You can symbolically view the limbic area by making a fist and then partially unclench your fist and looking at the palm of your hand. You can see the ventricles of the brain (Note the folds in the palm of the hand), as well as, the mounds and depressions of the limbic area itself. These biochemical systems are activated by the emotions of the learner. Here, too, are processes that enhance or inhibit memory. In this area such diverse emotions as anxiety, rage, and sentimentality can be expressed. Emotions can affect our attention span allowing us to focus and remember experiences or suppress and forget them. In addition, our feelings of personal identity and uniqueness depend on this area of the brain to combine internal and external experience. It is in this area that our emotions and feelings provide the connecting bridge between our inner and outer worlds and add significantly to our construct of reality and our view of the world. By the release of biochemicals from the limbic area, the cells of the cortex (i.e., the covering of the brain) are either facilitated or inhibited in their functioning. Activators for this area are novelty and experiences that involve deeply felt emotions.

Note to teachers: using novelty and physical experience to present what is to be learned increases understanding and helps students remember what they learn. The affective function does more than support cognitive processes. It does, in fact, provide the gateway to enhance or limit higher cognition. To allow optimal learning, families must include activities that promote emotional growth in the child’s environment and teachers must integrate such activities into their lesson plans.

The Cognitive Function (Linear and Spatial)

To the Students: The third system of the brain, the Cognitive Function, is located in the convoluted mass that covers the brain known as the cortex or cerebrum. The cortex is represented in our hand model (See Figure 5, p. 28) by the exposed surface of the fingers and the backs of both hands when held together with the fingernails touching. It is the largest brain system, comprising five-sixths of the total brain mass and provides a cover or outer layer over the two systems previously mentioned, the brain stem and the limbic area. It is here in the cortex that data are processed, decisions made, actions initiated, and memory stored. The cortex is necessary for language and speech. Its most overriding functions involve the reception, processing, storage, and retrieval of information. The cortex has been acknowledged as the seat of intelligence. Almost everything we think of as intelligence—perception, language, imagination, mathematics, art, music, and planning—occur here. You can get a sense of the six levels of layering that are involved in the cortex and just how thin this important covering is by stacking six business cards or playing cards on top of each other.

Our cognitive or thinking functions include the linear-analytic, problem-solving, sequential, and evaluative specializations of the left hemisphere of the brain (In the hand model, your right hand), as well as, the more spatially oriented gestalt specialization of the right hemisphere (Your left hand in the hand model).

Remember, in your hand model, the brain is facing you and your left hand represents the right hemisphere, your right hand represents the left hemisphere.

Growing your intelligence requires increasing the number of dendrites and their branches on each cell and accelerating the activity between the synapses, making more connections among them possible. It is this faster, higher level of activity that allows the establishment and maintenance of complex networks of thought and higher levels of intelligence. Stimulating environments promote the growth and branching of dendrites resulting in an advanced capacity to generalize, conceptualize, and reason abstractly. When you engage in challenging mental activity, you are increasing the number of your dendrites and their branching! They help you develop more of your brain and you become smarter.

The Intuitive Function

To the Students: This fourth function is located in the most recently developed section of the brain, the prefrontal cortex, located at the very front of your brain. In our hand model, the prefrontal
cortex is represented by your thumbs. The prefrontal cortex of the brain focuses on behaviors associated with planning, organizing, and creating, as well as intuition, insight, empathy, and introspection. Intuition has been referred to as one of the four basic human functions. The intuitive function involves creativity, imagination, and knowing without knowing how you know. It is an exciting area. It is engaged in firming up intention, deciding on action, and regulating our most complex behaviors. It seems to be the area that energizes and regulates other parts of the brain.

The function of intuition, which we all have but use in varying degrees, represents a different way of knowing. Activating intuition gives a person a sense of completeness, or wholeness. This powerful tool leads to the understanding of concepts and people and to an expansion of the reach of the mind.

To the Teacher: The following functions of the prefrontal cortex are believed to develop around 16 years-of-age, although for many analytic, integrative thought may develop even later. For gifted learners the involved thinking processes may be evident earlier.

- **Foresight:** Ability to see patterns of change, to extrapolate from present trends to future possibilities. This process uses imagination, prediction, and behavioral planning.
- **Self-regulation:** Regulation of bodily processes through insight, internal commands, and generation of visual images. This is the basis for meditation and biofeedback strategies.
- **Analytic systems thinking:** A high form of creativity that includes complex analysis of input requiring formal logic and metaphor.
- **Holos:** Social sense, including rational and emotional involvement; the foundation of altruism.

Intuition is defined and viewed by different researchers and writers in different ways. Intuition may be understood as the direct perception of truth or fact independent of any reasoning process; immediate apprehension; a keen and quick insight; and/or pure, untaught knowledge. Carl Jung, an early psychologist, stated, “Intuition does not denote something contrary to reason, but something outside the province of reason.” He considered intuition vital to understanding. Later psychologists discussed intuition as an important part of the education process and encouraged its training. Current physicists tell us that rational knowing is useless if not accompanied and enhanced by intuitive knowing.

Teachers will find that the development and implementation of strategies for integrating intuition into the classroom can be facilitated by three basic steps: Quiet the mind, focus attention, and adopt a receptive attitude. These simple steps cannot be developed unless teachers regularly allow time for them, practice them, and value the outcomes.

Many of those working to include the development of intuition in the educational setting believe that the ability to concentrate and to work at complex tasks with unusual clarity result from the intuitive function. Identified now as a part of the function of the prefrontal cortex, intuition becomes a part of the planning, future thinking, and insight so necessary to the intelligent person.

An example of an exercise that uses intuition as a learning tool follows. To teach concepts such as diameter, radius, and circumference, ask students to close their eyes and visualize a large, round swimming pool. Ask them to swim around the edge of the pool; tell them that they are now swimming the circumference of the pool. Ask them to swim from the side to the middle of the pool; they are now swimming the radius of the pool. Ask them to swim another radius back to the edge and then swim directly from one side of the pool to the other; tell them that they are now swimming the diameter of the pool. Ask the students to gently open their eyes and as you write each term on the board ask them to describe how they swim a radius, diameter, and a circumference. You will be surprised how easily the students gain this knowledge.

Under stress, the cortex begins shutting down, turning over more and more functions to the lower, limbic area of the brain. While rote learning can be continued, higher and more complex learning is inhibited. Creating opportunities for the effective operation of the total brain is our responsibility as parents and educators.

Research data from the neurosciences suggest that a high level of intelligence is the result of advanced, highly integrated, and accelerated processing within the brain. The concept of intelligence—and, therefore, giftedness as a label for high development of intelligence—can no longer be confined to cognitive function; it clearly must include all brain functions and their efficient and integrated use.

To the students: From these perspectives we end up with four somewhat different brains in one: (1) the brain stem—the smallest and oldest part of the brain; (2) the structures of the limbic area; (3) the cortex or cerebrum—the six-layered, largest part of the brain; and (4) the prefrontal cortex—the newest, most sophisticated section.

As you go about your classroom activities it really is up to you how intelligent your brain will become. When you feel like the challenges are too much and you do not want to work so hard, remember all those brain cells waiting to be used, wanting to grow, waiting for you to challenge them to a higher level. The harder your learning is the more you can use your brain and the more dendrites you will grow. You can do it!

*Do it for your dendrites!* 

**RESOURCES:**


BARBARA CLARK, Ed.D., is a Professor Emeritus at California State University, Los Angeles. Dr. Clark is the author of the widely used text, *Growing Up Gifted,* now in its seventh edition (2008), published by Merrill/Prentice-Hall. She is a past president of the California Association for the Gifted, The National Association for Gifted Children, and the World Council for Gifted and Talented Children. She is the Advising Editor for *Gifted Education Communicator.*
The Mystery of Science

Every subject in school has its allure. Language is an adventure into meanings and the nuances of its words. Mathematics is a puzzle that has specific steps leading to answers after you learn the process or the logic. But science—science is mysterious. Science needs a passport; you need to know the code. It’s like walking through the door in C.S. Lewis’s The Lion, the Witch, and the Wardrobe.

Science is mysterious because it is not a subject that is learned and relearned each year in school, as is reading or basic math. You have no gradual preparation that would occur if science were a topic studied each year from kindergarten on, as are other subjects. If you are blessed with teachers who love science and teach it yearly, it becomes a natural, sequential topic. But that is the exception and not the rule in most elementary schools—especially since No Child Left Behind allows time only for reading and math.

And so when science hits you all at once in junior high school or high school, you either love it as though you were waiting all your life for the information, or you think that this subject is alien, thus making you feel stupid. Perhaps you even rationalize and believe that science is boring.

That’s when science attaches itself to the smart kids—even when all the students are in advanced classes. And that is a shame because science is full of hands-on learning and could engage all levels of students. Even if science attracts the more capable students in terms of careers, it could also create a respect and a general knowledge on the part of our whole society.

In a discussion on National Public Radio, Walter Isaacson, writer and biographer, differentiates between attitudes toward science in the days of Benjamin Franklin, Thomas Jefferson, Thomas Edison, and the attitudes we carry in modern times. He said, “…in the time of Benjamin Franklin and Thomas Jefferson, no educated person would go around bragging they didn’t know anything about science because people like Franklin and Jefferson believed it was important to understand the beauty of science.” In that same discussion Isaacson suggests that the general public may feel intimidated by science.

Another writer, Carl Edwin Wieman, is an American physicist at the University of British Columbia and a Nobel Prize winner in physics. He addresses the problem of attitudes toward science on the part of the general public. These are some of his “science” thoughts:

- We pile on too much information in the form of lectures; too much rote information is not engaging. “Reduce Cognitive Load!”
- There simply isn’t enough time at school to transfer strategies to long time memory; therefore carefully designed homework assignments, grading policies, and feedback along with extended effort is necessary to be productive.
- Make connections between different ideas presented, and make connections to things students already know.
- For each topic covered, tell why the topic is worth learning, how it operates in the real world, and why it makes sense.
- The idea that optimum teaching and learning styles are specific to each individual teacher and student is a myth.

In education we have always prided ourselves on addressing each child’s individuality.

However, Dr. Wieman believes that “all people learn by building on their past knowledge and thinking” and that “it is well established that true expertise in anything requires thousands of hours of such intense effort and, perhaps surprisingly, natural ability has at best a minor influence on the amount of time required.” (Think about that one!) In essence, he is saying that this process isn’t so individualized because it is common to all learners.

So what can we take away from Walter Isaacson’s and Dr. Wieman’s thoughts? Science can be intimidating, and needs to be made more engaging and less burdensome.

That all may be true, but those who read this journal are educating gifted students. And it is our obligation to take all these suggestions to an even higher level and entice our children to be excited about the subject while also insisting upon diligence. We can do this if teachers are better educated in the field of science. We could, for example, avail ourselves of a program called STEM: The Science, Technology, Engineering, and Mathematics Education Coalition at the U. S. Department of Education, the National Science Foundation, and other agencies that offer STEM related programs.

Industry may have siphoned off full-time scientists from our field, but teachers can be superb students themselves, can clamor for training, and can become a sidebar of educational scientists in their own right.

Perhaps we need pompons and a rally!
Presentations can be greatly enhanced with visual images and key words that help focus the conversation. The most popular software for this compels us to carefully plan our presentations and order slides so that we can articulate our ideas in an efficient and orderly linear fashion. Many speakers dislike the linear limits of such programs—and use an overhead projector or document camera so that they can choose the order based on the needs and interests of the audience.

At a recent Cluster Two BTSA meeting, Matt Zuchowicz shared Prezi, a presentation tool that was being used in Santa Barbara to illustrate presentations and facilitate reflective conversations with beginning teachers. After a fifteen minute “show and tell,” my mind began to race about how this tool might be helpful to gifted students. When I returned to my office, I registered for the free educator version of the program and began to play. Within a half-hour, I had my first Prezi completed.

Prezi, available at www.prezi.com, offers a presentation tool that is much more like a mind map than an outline. When a new file is created, the user can insert text or upload picture, video, or PDF files. A three-tier circle tool called the Transformation Zebra allows the author to change size, rotate the text or image, and place it anywhere on the canvas. Hierarchy of ideas is represented by relative size, and ideas can be grouped by adding frames. Tutorials show how to group and frame ideas to reduce panning and create visual connections between similar ideas. A path can be created so that the presentation can be shared in the play mode, or the presenter can detour from the path by panning on the canvas to choose an idea or group in response to an interest from the audience. At the more advanced level, users can add looping animation and a scaled narrative.

In the presentation mode, the audience can see the entire canvas, or can be directed to details. When details are presented as a part of a larger picture, context adds to the meaning and understanding. The ability to move along a path, or to take a detour from that path, frees the author to speak on a topic, as well as respond to an audience.

For gifted students, Prezi gives an opportunity to create a report as a spatial story on a canvas, with relationship and hierarchy. This can create a powerful challenge to transform the process from retelling facts to creating connections and sharing vision. The program has enough structure to support a programmed pathway and enough freedom to allow departure from the path. In addition to the intellectual support provided by the platform, the company provides opportunities for access at varying financial levels. Prezi has a public option so that anyone can log on and play with ideas on a creative platform. The full version of the program is available to students and teachers. Presentations can be viewed from the website or downloaded and sent to the venue where they will be shared, even if the venue does not have a license for Prezi.

Tutorials on the website fully explain the options and create the possibilities. Visit www.prezi.com, then begin a project to learn the technology. It is my hope that this platform will be one in which technology helps make connections and creates understanding.

Beth Littrell, M.Ed. is the Resource Specialist for GATE, BTSA Advisor, and RTI2 Middle School Facilitator in the San Mateo-Foster City School District in California. She has worked with gifted students and their teachers for 26 years. She serves as Associate Editor for Curriculum & Instruction for the Gifted Education Communicator.
101 School Success Tools for Students with ADHD

By Jacqueline S. Iseman, Stephan M. Silverman, & Sue Jeweler
paperback, $16.95, 224 pp.  

REVIEWED BY ELAINE WIENER

Living with an ADHD child is difficult enough, but add to that concept a gifted ADHD child, and the problem is intensified.

One of the disadvantages of using words in paragraph form is that specific thoughts blend and can lose their impact. However, this cannot happen in a book that has 101 tools, all in list form, to solve or ease ADHD problems.

Every page, every tool consists of lists and lists and lists. For example, Tool 57: How ADHD Feels to Me (p.107) shows a list of characteristics that the reader can check off. Here is a small portion:

- My mind is racing all the time.
- I say or do the wrong thing before I think about it.
- When I try to write down what the teacher says, I forget much of it.
- I feel nervous a lot of the time.
- I can’t help making a mess wherever I go.
- I get bored very easily.
- I prefer to be in motion all the time.
- I argue a lot.
- I get emotionally excited very easily. And dozens and dozens more ideas on each page...all in that valuable list form.

I cannot exaggerate the value and the variety of the information in this book. Adding to the help this book provides for parents and teachers of ADHD children, is the fact that the bibliography is full of names of authors with backgrounds also in gifted education.

By the way, there is not one recommendation in this book that could not be used with all children. It certainly will focus parents and teachers who may feel ADHD themselves merely from overload.

ELAINE S. WIENER is Associate Editor for Book Reviews for the Gifted Education Communicator. She is retired from the Garden Grove Unified School District GATE program. She can be reached at 1elaine@att.net.
A Little Book of Language

By David Crystal
(2010) Yale University Press
hardcover, $16.50, 260 pp.
ISBN 978-0-300-15533-4

REVIEWED BY ELAINE WIENER

There must be a million books written about language. At least it feels that way. In addition, this book about language is not written specifically for gifted education. But I can’t think of any book that is more appropriate for gifted minds who want to know why and how words come into being.

The book jacket says that David Crystal is one of the world’s pre-eminent language specialists. His humor and good heart can be added to that description.

He starts out with baby talk. All the silly things you have ever said to a baby, all the goings you have ever done without embarrassment—or with—and all the funny faces you have ever made are described in meticulous detail along with scrupulous explanation. There are more reasons than you really want to hear, but the humor weaves in and out to compensate for all those elements. This book could be material for a standup comic!

Chapter One is baby talk, and Chapter Two takes us from cries to words. In this chapter we learn how cries sound with letters going up and down the page showing us how intonations look. You find yourself making sounds to see if he is accurate. And he is!

Each chapter evolves in the same way that children develop language. For example, he shows us how the sounds [d] and [t] differ. The explanation is so descriptive that you mumble as you read.

The rest of the book is a lifetime of study: how we understand, making vibrations, pronouncing sounds, grammar, making conversations, learning to read and write, spelling, accents, dialects, being bilingual—forty chapters that will entertain you as they educate you.

You want A Little Book of Language in your library; it would also be a unique gift for discerning friends.

ELAINE S. WIENER is Associate Editor for Book Reviews for the Gifted Education Communicator. She is retired from the Garden Grove Unified School District GATE program. She can be reached at 17elaine@att.net.

Igniting Creativity In Gifted Learners

By Joan Franklin Smutny and S.E. von Fremd
paperback, $38.95, 325 pp.
ISBN 978-1-4129-5778-6

REVIEWED BY ELAINE WIENER

Joan Franklin Smutny, the founder and director of the Center for Gifted at National-Louis University, and S.E. Fremd, an independent scholar and writer in education, cultural studies, and dance, have used their own colorful backgrounds to collect creative experiences in classrooms around the country.

In the introduction, Smutny and von Fremd refer to the legendary teacher, Albert Cullum, and although his work is over 50 years old, a creative teacher who likes to dig in used book stores will be excited by the discovery of his books and ideas. I was fortunate enough to own and use his book, Push Back the Desks, in my own classroom for over 35 years. Best of all, I also spoke to him over the decades. What a privilege!

Albert Cullum is used as an example for this book because he had unlimited hands-on ideas, making academic curriculum come alive. He was doing this long before it was a common application in teaching. And all the chapters have similar examples from today’s classrooms.

Each lesson is highlighted and enhanced by the style and format used by the editor-authors: Main Concept, Level, Application, Description, and the rest of the breakdown is applicable only to each particular lesson. The specifics are rather amazing because they point out divisions not necessarily noticed by the authors even though it is their own work.

When you read these lessons, you easily may want to use them in your own classroom and immediately see how your own “productions” will fit into this easy style. It is obvious that Joan Franklin Smutny and S.E. Fremd have a magical quality of their own by the way they have gathered and painted all these excellent examples.

ELAINE S. WIENER is Associate Editor for Book Reviews for the Gifted Education Communicator. She is retired from the Garden Grove Unified School District GATE program. She can be reached at 17elaine@att.net. She can be reached at 17elaine@att.net.
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(for mailing addresses outside the U.S., please add $15)

Role

☐ Administrator/Coordinator
☐ Board of Education Member
☐ Consultant
☐ Counselor/Psychologist
☐ Grandparent
☐ Parent
☐ Teacher
☐ Other

Special Skills/Interests

☐ Art/Music
☐ Humanities
☐ Math
☐ Science
☐ Advocacy/Legislation
☐ Computers
☐ Other

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