

NCSSSMST Journal

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Spring 2008



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On the Cover

Past Presidents pause for celebration.

Left to right: Dr. Cheryl Lindeman, Dr. Richard Loftin, Dr. Betty Stapp, Dennis Lundgren, EdS, Dr. Joan Barber, Dr. Ronald Laugen, Dr. Stephanie Pace Marshall

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Editor's Note

by Jay Thomas, EdD

The spring and forthcoming fall 2008 issues of the NCSSSMST Journal stand as reflections and celebrations of twenty years of our transformative work and powerful collaboration across the NCSSSMST community. In the spring 2008 issue, we present reflections and challenges from NCSSSMST past presidents, whose oversight, direction, and vision to lead our organization to where it stands today, as a national resource for the development of talent in STEM education. And in the fall 2008 issue, we will present a special alumni issue, comprising reflections and observations from alumni of Consortium schools.

While these issues provide solid evidence of our progress and good work, as an NCSSSMST board member and as its current president, I have been wrestling with the question of what makes NCSSSMST truly relevant. This is a vexing question for many of us at the school level – how do we demonstrate to our stakeholders that our specialized schools are worth the human and financial investment? And as an organization, I believe that NCSSSMST should be prepared to respond to the same question.

Each of us, I am sure, can point to a variety of

indicators of our respective schools' successes – distinguished alumni, award-winning educators, innovative curricula, impact on local or state education policy, and so on. But if we were asked to make a case for ourselves as an organization, what evidence could NCSSSMST point to? How might we look across our member schools and suggest that our organization is doing what it says it is doing?

I pose these questions not as shortcomings but as an invitation to member schools to consider actively supporting research initiatives within and across institutions and to share their findings in future issues of the NCSSSMST Journal. As I have mentioned in several forums, it is easy to claim that to put talented students and exceptional educators in the same classroom, good things are bound to happen – and we see it daily. But as a research psychologist, I am always interested in knowing why it happens. And, once we begin understanding this dynamic in schools like ours, once we begin sharing those understandings with the educational community, I believe we will have made tremendous progress in asserting our place in STEM education.



Jay Thomas, EdD, is Co-Editor of the NCSSSMST Journal and the 2008-2009 NCSSSMST President.

President's Message

Dr. Jerald (Jay) Thomas

Twenty years ago, our organization comprised sixteen member schools organized around common commitment and understanding of our unique charges. Since 1988, we have invited colleges and university affiliates to advance our mission. Over the last few years, as an organization, we have begun to develop opportunities for middle school students, students from under-represented groups, and low SES communities, while also beginning to explore our potential contributions to national science education policy. All the while, we have remained not a Consortium of specialized schools, but a Consortium for its constituent members.

In February 2008 at the NCSSSMST Professional Conference in Dallas, Dr. Stephanie Pace Marshall's keynote address reminded us that our work and charge extend well beyond the teaching and learning of mathematics, science, and technology. Dr. Marshall, NCSSSMST's founding president, spoke to our accomplishments over the past two decades, as well as to the work that will define us for the next two decades. I am particularly challenged by these questions from Dr. Marshall's address:

"[W]hat will it take to transform STEM education in this world? What will it take to stop the erosion of our children's minds and the quality of their critical and creative thinking? What will it take to ignite and nurture their desire to be pioneers and to advance the STEM frontier and the human condition?"

The erosion of a potentially creative mind is a troubling and powerful metaphor, but what makes this prospect especially daunting is that the erosion of the mind, the lack of engagement with math and science (or the arts and humanities, for that matter) and the sapping of creativity and critical thought begin long before students reach our secondary schools. We are fortunate to have high achieving and talented students in our classrooms, but we have a responsibility to the broader community to address this damaging prospect before the prospective contributions of another generation are diminished through systemic, benign neglect. Our response to such challenges must be systemic:

- Reflect on and reconsider our mission, vision, and goals;
- Assess our organizational resources; and
- Determine how NCSSSMST can position itself as a national resource and an authoritative voice in STEM education and policy.

As President of NCSSSMST, I have challenged the board of directors to invest the next year of its work toward redefining the mission of the organization and perhaps recasting the work of the board itself. We are not the same organization that we were twenty years ago: we are more experienced, we have more human and intellectual resources, and we are in a position to truly transform STEM education. I hope you will join us.



Jay Thomas, EdD, is Assistant Professor of Education and University Assessment Coordinator at Aurora University and current President of NCSSSMST.

Blessed Unrest: The Power of Unreasonable People to Change the World¹

Keynote address by Dr. Stephanie Pace Marshall at the 2008 NCSSSMST Professional Conference, March 2008

Thank you, Cheryl. Good evening, everyone, and Happy 20th Anniversary! It's a joy to be here.

There is an African saying, "If you want to go fast, go alone. If you want to go far, go with others"—and going far together has been the story of this Consortium for over two decades. It was my privilege to serve as our Founding President, and it is an even greater joy to see how far we have come, and to celebrate this milestone together.

Almost a year ago, I was at my writing desk trying to do what I am supposed to do there—which is write. I prepare several speeches and presentations during the year, but this time, I was writing just for me. It's my way of getting clear about my thinking, because if I can't write it—I simply don't get it!

Usually sustained thinking, punctuated by dancing to Kenny G, Josh Groban, or the Dixie Chicks, helps to lift the fog, but not this time. This time, clarity completely eluded me, and all I could do was list my myriad of questions.

The longer I sat, the longer the list became; yet the more complex, significant and interesting, my questions became, as well. Finally out of sheer frustration, I put my hand on my head and said quietly, *oh Blessed Unrest*. I didn't know then where that phrase came from and why it popped into my mind. I do now and I'll come back to it at the end of my comments. But it stopped me cold.

Blessed Unrest—the possibilities inherent in the paradoxes that define us and keep us alive, searching and committed to making our unique difference in the world, because of who we are. When I said those words—Blessed Unrest—I recognized that despite my frustration, I was actually grateful for my uncertainty; for my

insatiable curiosity, my relentless search for clarity and meaning, and my unforgiving questions that grabbed hold of me and would not let me go.

I was quite literally blessing the fact, that it is my passionate pursuit of these questions that actually keeps me awake to the work that I need to do NOW; and that keep me from living a life far too small for my imagination. As human beings, we always walk in the direction of our questions.

Several months later, I was browsing in Borders Bookstore, and I came across Paul Hawken's new book, *Blessed Unrest: How the Largest Movement in the World Came Into Being and How No One Saw It Coming*. Hawken is a world renowned environmentalist. You may be familiar with some of his previous books:

- *Natural Capitalism: Creating the Next Industrial Revolution*
- *The Ecology of Commerce: A Declaration of Sustainability*

But this book, *Blessed Unrest*, is a manifesto—a compendium and a taxonomy of global initiatives that change the face of activism for social justice and ecological health. It is a treasure, describing what Hawken calls the "movement with no name."

So fast forward. I am sitting at my desk again, trying to write my reflections for tonight and my husband brings me a *New York Times* article written by Nicholas Kristof ("The Age of Ambition," Opinion Page, 1/27/08).

Kristof is a *New York Times* journalist and someone whom I greatly admire. He has brought the voice and the face of the Darfur genocide into the public's consciousness.

Kristof was writing his article from Davos, Switzerland, and the World Economic Forum. In the article, he contrasted the power of the corporate and political elite to change the world with the power of a growing cadre of young social entrepreneurs who are doing the same thing—only very differently, not through investment philanthropy, but through community grassroots efforts and expanding social and entrepreneurial networks that are growing dynamically and organically around the world.

In the article, Kristof referenced Bill Drayton, the CEO of Ashoka—a remarkable organization that supports social entrepreneurs. He quoted Drayton as saying, “social entrepreneurs neither hand-out fish nor teach people how to fish; their aim is to revolutionize the fishing industry.”

Kristof also cited a new book written by two social entrepreneurs, John Elkington and Pamela Hartigan; it’s superb, and it is titled *The Power of Unreasonable People: How Social Entrepreneurs Create Markets That Change the World*.

So quite serendipitously between these two books, I had the context of my comments for tonight: “Blessed Unrest: The Power of Unreasonable People—you, me, our students, our staffs, and our partners—to Change the World.” Not by handing-out new programs, not by teaching kids how to master test-taking, but by revolutionizing and transforming STEM education for all our children.

Once I decided what I wanted to say, it seemed like a worthy conversation for our third decade. At the very least, it seemed like a defensible reason to hold you captive for a few minutes.

So let me set the context for my comments. If we were prospective hires at Google, we would be asked the following question: “If you could change the world using Google’s resources, what would you build?”

The question I have for us is far more modest: “If we could transform our system of STEM education P-20 using the current and potential

resources of the Consortium, what would we do?”—especially in light of the fact that the international playing field is ubiquitous, ageless, and boundary less and “Beijing, Bangalore and Bethesda are now next door neighbors” (Dr. Norm Augustine, Chairman of the Report: *Rising Above the Gathering Storm*).

So what will it take to transform STEM education in this world? What will it take to stop the erosion of our children’s minds and the quality of their critical and creative thinking? What will it take to ignite and nurture their desire to be pioneers and to advance the STEM frontier and the human condition?

We know it will take multiple systemic actions; I’ll focus on three.

1. The need to transform the way mathematics and science are taught so school science and math and real science and math, are the same and not estranged—right now, you can’t recognize real science in school.
2. The need to transform the way mathematics and science are learned so all children are immersed in the knowledge, skills and habits of mind essential for doing real science—ethical inquiry, and creative and collaborative problem-finding and solving.
3. The need to transform our nation’s system of STEM education P-20, so that innovation is ignited and sustained, and the language of mathematics and science is “spoken” and understood by all Americans.

Whether you believe we live in a “flat world” (Tom Friedman) or a “spiked world” (Fast Company), or both, we are living in a challenged world.

I once asked a conductor friend of mine why it is that more conductors come out of Finland than any other country. His answer: “Everyone in Finland speaks music!” Just imagine who we might become as a nation, if everyone could speak math and science, even a little!

So, let's begin:

First—transforming the way science is taught in school so that real science and math and school science and math are not estranged.

We now know that children come to school with intuitive scientific reasoning, innate curiosity, and the ability to discuss and generate hypotheses and do experiments (*Taking Science to School*). It is simply who we are. We are driven by perplexity, captivated by anomalies, intrigued by complexity and paradox, and drawn to the novel and the impossible—and the more impossible, the better.

But, there's a huge disconnect between our children's innate curiosity about the world and how it works, and the science they "do" in school. Howard Gardner captures this well:

"Imagine if we taught baseball the way we teach science. Until they were 12, children would read about baseball technique and occasionally hear inspirational stories of the great players. They would answer quizzes about baseball rules. Conservative coaches would argue that we ought to make children practice fundamental skills, like throwing the ball to second base 20 times in a row, followed by tagging first base 70 times. Others would reply that the economic history of the reserve clause proved that there was no such thing as 'objectively accurate' pitching. Under strict supervision, undergraduates might be allowed to reproduce famous historic baseball plays. But only in graduate school would they...actually get to play a game." Gardner concludes: "If we taught baseball this way, we might expect about the same degree of success in the Little League World Series that we currently see in science performance."

It sounds ludicrous—but for many children, this is exactly what happens. School science has become a spectator sport, not a live encounter.

And why is this? I think it's because our culture's story—our "meta narrative" about science, math and technology—what they are, who can and can't "do"

them and why they matter, is not only dysfunctional, it's dishonest. It's also dull, exclusive and arrogant.

How we currently teach and talk about science, scientists and even science teachers has created a mental model—a blueprint—that is incongruent with what science really is.

Sadly, most students experience science as:

- passive acquisition of huge amounts of prescribed and inert content and compliance with what the teacher says is true and important; the tyranny of coverage has left no time for exploration or for following questions wherever they may lead;
- devoid of joy, wonder and awe, and if you dare bring them into the classroom you do so at your peril, because "everybody knows" that emotion distorts reason;
- isolated from other disciplines and taught in silos; interdisciplinary science is often viewed as "soft";
- isolated from its social context and detached from the human experience;
- getting "right answers"; science is all about memorizing taxonomies, periodic tables and algorithms;
- not for them; they believe you're either "good at" science or you're not, and you can't do much to change it—it's in your genes and you're doomed by your DNA.

This is an insidious and tenacious story—and it is very, very difficult to change. And the consequences for individual children, our nation, and our global community are enormous. Immersion in this kind of reductive, disengaged, and sterile landscape leads to entrenched, risk averse and uncurious minds, lacking the conceptual scaffolding and maps to navigate new or novel terrain—

- unaware of the breakthroughs that happen at the edges and intersections of disciplines,
- unable to ask and explore powerful questions,
- and holding a sense of detachment from science as a way of deeply understanding the human experience, as well as their own.

The danger of school science is not only the emergence of shallow and unimaginative thinking,

but the seeding of a relativistic, superstition-prone, and situational view of science that causes us to dismiss it as too theoretical, reject its conclusions, or ignore its warnings.

As Al Gore said in his recent book, *The Assault on Reason*, “we must stop tolerating the rejection and distortion of science” (p. 10).

Steven Colbert from *Comedy Central* might describe us as suffering from scientific “truthiness”—the intuitive ability to determine truth without facts! My whole point is that in our culture and for most people, science simply doesn’t matter very much. That’s why it is not embarrassing to claim or even brag that we’re not very good at math or science. It’s simply okay—sometimes actually a badge of normalcy—and it’s especially okay if you’re female.

We know of course that real science is fundamentally different. It is about skillful and passionate inquiry; deep analysis and reflection; hypothesis generation and experimental design; relentless and uncompromising skepticism; evidence-based judgment; and the immersion in wonder and awe. School science has completely misrepresented and distorted the scientific enterprise and its contributions to world-changing.

To educate our children as pioneers in an unknown land requires their immersion in meaning, not memory; engagement, not transmission; inquiry, not compliance; exploration, not acquisition; personalization, not uniformity; interdependence, not independence; collaboration, not competition and trust, not fear.

Changing the story of this stark disjuncture between school math and science and real math and science is so fundamental to our ability to transform STEM education because, by design, the very system that is supposed to “pump” students into the STEM “pipeline,” is actually filtering them out. In fact, I am coming to the conclusion that the very metaphor itself, “pipeline,” is part of the problem because once again, it reinforces the wrong story. Pipelines imply limited access, competition, a narrow trajectory, and an inability to get out or in if you change your mind.

Internet kids don’t like or even see pipelines; they want to co-create, collaborate, and convene. There is a webbed world of global connections and social, technological and entrepreneurial networks. Pipelines are completely irrelevant to them; they slow things down, and they get in the way. Internet kids not only want to change the rules, they want to change the game and pipelines don’t lend themselves to game changing; all you can do is “go with the flow.”

We clearly need a new metaphor. We need to think of talent magnets, sandboxes, arboretums, or networks, but not pipelines.

There is an enormous disconnect between our nation’s demand and expectations for innovation, and the demands and expectations of the current story, map and landscape of school science and mathematics. We have a seriously flawed design, and we are getting precisely what we designed for. School science completely misrepresents and distorts the scientific enterprise and its contributions to world-changing. And this is where we come in as a Consortium, we can tell the real story of science—loud and clear—because if we don’t, we won’t be able change the system. Even in our data-driven culture, narrative trumps data every time.

Let’s move on to the second action—transforming the way math and science are learned so all children are immersed in the knowledge, skills, and habits of mind essential for doing real science. What will it take?

I believe it will take a new map—a new design, and as STEM leaders, we have significant experience with what it needs to be:

- (1) Concept-centered, experiential and integrative curriculum, so children understand fundamental science concepts, deep organizing principles and linkages, and how science builds knowledge and enriches the human experience;
- (2) Inquiry-based, problem-centered, and technology embedded instruction, so children engage in the process of doing science, not as an experimental “recipe,” but as an unfolding inquiry because real world problems are messy,

complex, and tangled and science knowledge is tentative;

- (3) Extensive practice and immersion in self-determined and self-directed investigation and research with mentors and peer collaborative teams, in real and virtual laboratories and incubators, and in the natural world so that students are immersed in the joy of doing real science;
- (4) Authentic, on-going, multi-dimensional, and performance-based assessment; so children are invited to creativity demonstrate evidence of their understanding, in multiple and novel ways.

The new map—new design—must enable children to engage in authentic, scientific thinking. Rewarding the illusion of learning at the expense of deep and creative thinking endangers our children, our nation, and our future. When information acquisition masquerades as learning and high stakes test scores masquerade as understanding, our children's motivation and ability to think critically, creatively, systemically, and long-term is diminished. If we did nothing else to erode the minds of our children, this would be enough. As a Consortium and as a nation, we have what we need to transform STEM education. Now it is a matter of will—and who better positioned than us to become the unreasonable catalysts and voices.

This brings me to the last dimension: How we might transform STEM education P-20 and create a dynamic system for STEM innovation so that:

1. the real story of science and mathematics is taught and learned;
2. advances in neuroscience, cognition and learning technologies drive system design;
3. new structures and rules of time, place, grade level, age, and curriculum are turned upside down;
4. imagination and inquiry are ignited and nurtured;
5. innovation is scaled and sustained;
6. the language of math and science is spoken and understood; and
7. our children and our system can access the collective intelligence of the emerging “global mind.”

Before I talk about what we can do as a nation, I want to focus first on us—our consortium. In

2006, Governor Napolitano, then President of the National Governors Association, recommended a mathematics and science academy in every state, so did the report, *Rising Above the Gathering Storm*. Now this recommendation is codified in the America Competes Act.

We have been told that our paper, “Addressing the STEM Challenge by Expanding Specialized Mathematics and Science High Schools,” influenced this legislation. So we’ve made a powerful contribution and our forthcoming book, *Schools Like Ours*, can make an even greater one. But now since our numbers will likely increase, we need to move from an alliance, to a real and virtual global STEM Innovation and Talent Development network that co-creates, generates, shares, and translates our unique intellectual and creative capital.

So what might we do if we saw ourselves in this way—as a dynamic, global STEM innovation and talent development network, with each of our institutions serving as a hub in a regional network for innovation and inquiry? We have the social networking tools and the next generation learning technology to do it and some of these technologies have been invented by our alumni!

The “final answers” will come from our collective and unreasonable imagination, but let me offer some possibilities and the roots are already being watered by our Board of Directors: We model ourselves after the Clinton Global Initiative University (CGIU) and create The Consortium Academy. Like CGIU, it would be an extension of the Consortium that reaches across all our campuses to engage our students and our institutions in work such as:

- identifying and solving some tenacious, complex and “wicked” (John Kao, *Innovation Nation*) local, national, and global problems;
- collaboratively designing and teaching courses and seminars online and enabling our students and staff to access (and even earn credit for) the full spectrum of the Consortium’s offerings and programs; an NCSSSMST online;
- collaboratively designing, conducting and sharing research on the impact of technologies like

Second Life, on cognitive development. We could also hold a conference on Second Life. I'd love to see what our avatar would like like!

- generating research questions about teaching and learning science and mathematics in light of breakthroughs in neuroscience—especially neuroplasticity and epigenetics; putting them out into the world and inviting the emergence of a community of practice;
- jointly creating programmatic prototypes to experiment with new learning, teaching and assessment strategies;
- developing entrepreneurial initiatives and seeking angel investors; IMSA alum are already doing this for one another. We could have our own Consortium Innovation Investment Network;
- creating “games for good,” where to win means you have advanced the human condition in some way;
- exchanging students and staff—including our global partners and “sister” institutions—through research, innovation, and design sabbaticals, and creating a Consortium Fellows Program;
- translating and transferring knowledge throughout our global network using open source technology and the creation of a global data warehouse.

NCSSSMST as a real and virtual global STEM Innovation Network would be a dynamic force for transformation.

And finally—let's look at our nation. What might our country do to transform our system of P-20 science and mathematics education. A year ago I was invited by the National Science Board to give testimony to their Commission on 21st Century Education in STEM. I recommended that they consider the chartering, by Congress, of a National Institute and Incubator for STEM Teaching and Learning Innovation. They were intrigued by the idea.

I explained that this Institute would not serve in a regulatory capacity. Rather, it would combine the entrepreneurial culture and the best designs of institutes and companies like the Santa Fe Institute, the MIT Multi-Media Lab, the Beckman Institute at the University of Illinois and the Biodesign Institute at Arizona State and companies like Google, IDEO, and CISCO—just to name a few.

Its purposes would be to ignite and nurture innovation and to generate, share and integrate the nation's vast scientific, creative, educational and technological resources to transform our system of STEM education. It would:

1. stimulate, connect and create synergies among multiple stakeholders, initiatives, research programs, and networks;
2. focus research on the implications of new learnings in neuroscience and cognition, and the effects of multiverse environments, such as Second Life on STEM education;
3. ignite and support innovation through multidisciplinary, transdisciplinary and interdisciplinary curriculum, instruction, assessment and professional development design and scaling;
4. accelerate STEM transformation through the prototyping and incubation of promising programs, practices at the state, regional, and local levels;
5. and ensure global national and state collaboration, integration and evaluation.

The Institute would also be a place where multidisciplinary stakeholder teams from around the country and the world would gather to develop designs and prototypes for new processes, structures, and programs in STEM—both real and virtual. The National Institute and Incubator would be part think-tank, part research and development laboratory, part skunk works, and part design center—the hub of a vast networked system of innovation linked to federal education and science laboratories, universities, museums, community-based science programs and innovative companies. It's just an idea—but ideas start conversations and conversations can start movements which harness the power of unreasonable people to change the world.

I said when I began that I would come back to the origins of the phrase, “Blessed Unrest.” It came from a comment that the legendary dancer and choreographer, Martha Graham, made to her friend, Agnes DeMille, another choreographer and dancer when they were in a restaurant in New York in 1943.

There are two versions of what prompted Martha

Graham to say what she did. One is that DeMille was very troubled by the eroding quality of her musical, “Rodeo,” after cast turnover. The other was that DeMille was mystified that her musical, “Oklahoma,” had been so successful when she felt that it was not as good as others the critics had neglected. Regardless of the stimulus, Martha Graham’s words are not disputed.

Here is what she said and I asked you to think about yourself and our Consortium as I read this:

“There is a vitality, a life force, an energy, a quickening, that is translated through you into action, and because there is only one of you in all time, this expression is unique. And if you block it, it will never exist through any other medium and will be lost. The world will not have it. It is not your business to determine how good it is nor how valuable nor how it compares with other expressions. It is your business to keep the channel open... You have to keep open and aware to the urges that motivate you. As for you, Agnes, you have a peculiar and unusual gift, and you have so far used about 1/3 of your talent...No artist is pleased... [There is] no satisfaction whatever at any time. There is only a queer divine dissatisfaction, a Blessed Unrest that keeps us marching and makes us more alive than the others” (Hawken. *Blessed Unrest*: 308).

When I read this quotation in Hawken’s book, I had a flashback and remembered reading it many years ago—obviously the phrase “Blessed Unrest” had remained with me—buried until now.

So, now at this moment—as individuals likely using only a third of our talents and as a consortium likely doing the same thing, what is the work we can now do together with the collective resources we have that beg to be shared and connected? What is the source of our Blessed Unrest that will give us the courage to become unreasonable advocates for our children and for STEM transformation?

My answer? It’s as simple as A-B-C-D!

A: We claim our authority and name and author a new story of school science and math, and lead the conversation about innovation and talent development in STEM.

B: We rigorously define the distinctiveness and integrity of the Consortium’s brand so it is crystal clear what putting our name on something means.

C: We create, collaborate, convene and connect continuously so that we grow our collective intelligence.

D: We dare to embrace our unique and remarkable talents and potentials

We don’t add value when we do what everybody else can do. We add value when we do what only we can do. So, A-B-C-D are the roots of The Blessed Unrest that can, in Martha Graham’s words, “keep us marching and make us more alive than all the others.

Well... I’ve come to the end of my talk. I didn’t intend to leave us with answers. I don’t have them; they must come from our collective genius. I did intend to leave us with questions and invitations, full of possibilities worthy of who we are and who we might become in our third decade—NCSSSMST 3.0—sure to keep us awake and alive and, I hope, in a state of perpetual and heightened Blessed Unrest. Happy Anniversary!

NOTE: ¹The phrase “Blessed Unrest” came from a quotation by Martha Graham to Agnes deMille and is the title of Paul Hawken’s new book, *Blessed Unrest: How the Largest Movement in the World Came into Being and Why No One Saw It Coming*. The phrase “the power of unreasonable people to change the world” came from John Elkington’s and Pamela Hartigan’s book: *The Power of Unreasonable People: How Social Entrepreneurs Create Markets That Change the World*.

Former Presidents Reflect on 20 Years of NCSSSMST

Compiled by Elizabeth Templin

The Consortium celebrated its 20th anniversary at the 2008 Professional Conference in Dallas, Texas in February 2008. Founding president Stephanie Pace Marshall and former presidents Joan Barber, Janet Hugo, Ron Laugen, Cheryl Lindeman, Dennis Lundgren, and Betty Stapp responded to questions about the organization and their involvement with NCSSSMST over the last 20 years.

Q: What was NCSSSMST like when you first got involved?

Stephanie Pace Marshall: NCSSSMST began in the spirit of Margaret Mead: “Never doubt that a small group of committed citizens can change the world; indeed, it is the only thing that ever has.” In 1988, a group of fifteen specialized schools decided that our common purposes and shared interests would be better served if we joined together to create a formal alliance and partnership. In a real sense the “founding fifteen” were the midwives of a unique institutional and professional collaboration that has advanced STEM education and talent identification and development in our nation.

Cheryl Lindeman: I had the opportunity to go to Thomas Jefferson High School for Science and Technology and represent our school at the 1988 gathering of like-minded educators working at new types of schools. How do we learn from each other, we asked? From then on it is history— I’ve been involved with NCSSSMST for 20 years!

Joan Barber: My impression when I first got involved was that it was an organization that had to be outstanding because it included other specialized science and mathematics schools like mine, the North Carolina School of Science and Mathematics. When I came to NCSSM as an administrator, it was clear NCSSSMST was

moving at a fast pace and was being positioned to have a national presence.

Betty Stapp: At my first Professional Conference (in New Orleans), I was impressed with the goals of the organization and the progressive stance of the Board in promoting math, science and technology innovation. The organization seemed to be desirous of moving to a new level and a more active role in improving education.

Dennis Lundgren: By 1992, the Consortium had a little over 40 institutional members. We were very dependent on individual schools to create and carry our major events. At the same time, we had a group of leaders with a vision of what the Consortium could become.

Ron Laugen: When I first got involved with NCSSSMST in the early 90’s, I was impressed with the commitment of the people I met, both to their own schools and to the new organization. We knew then how important it was that we develop multiple ways for people to connect. What I most remember was how much everything had to be done on a shoestring budget.

Janet Hugo: I remember wondering what the organization really did beyond offering three yearly events – Student Conference, Student Research Symposium, and Professional Conference. I enjoyed the networking that was available at the conferences. It was great to be able to share information with other school administrators and teachers.

Q: How has NCSSSMST changed over the years?

SPM: NCSSSMST has clearly evolved from an idea to a becoming a national leader in STEM

teaching and learning, especially for talented and motivated students seeking to pursue advanced study and/or careers in STEM fields. Since the creation of our first strategic plan, NCSSSMST has continued to become more strategic, proactive and connected—seeking not only to engage Consortium members, but the broader STEM community.

We have dramatically increased and diversified our membership by creating an affiliate partner status, and enrolling like-minded universities, corporations, and foundation; created annual student research conferences and staff professional development conferences; developed a thoughtful and respected journal for student and staff contributions; collaborated in joint longitudinal research of consortium students and national research initiatives; and shared institutional “best” and “most promising” practices. With the anticipated publication of our second book, *Schools Like Ours*, we will become an even more influential resource for STEM talent development.

BS: Since my first meeting, we have greatly increased its membership as well as become more active in developing products to improve curricula, teaching and learning. The organization has also been more proactive in seeking involvement with other math, science and technology organizations.

JB: The most obvious one is the membership, growing from 15 original member schools to over 100 institutional members and 110 affiliates and associates. Our publications on student research and starting new specialized schools are major accomplishments in connection with our mission to create synergies among schools engaged in educational innovation. And the outstanding new NCSSSMST website.

DL: We have grown – passing the 100 institutional member mark. We have impacted national policy with the report, *Addressing the STEM Challenge by Expanding Specialty Math and Science High Schools*, as well as through contacts with our elected officials. We have a National Office with an Executive Director to make the work of the Consortium more effective. We increasingly share

exemplary programs through our publications, conferences, networking and involvement with other organizations.

RL: Rejoining the Board after almost ten years, it was easy to say, “We have changed with the times.” We have more members and affiliates, a bigger budget, more programs and publications, and we are being recognized as a player on the national stage because of the important contributions of our member schools across the country. In particular, I believe members’ collaborative relationships with each other and with partners such as the Siemens Foundation, the College Board, and the Keystone and Sloan Foundations have benefited all.

JH: I have seen a tremendous amount of growth from an organization that was almost entirely a direct service-based one to one that now has a national leadership role. We have developed a very real sense of purpose and are accomplishing goals in a systematic and organized manner.

Q: How has your involvement with NCSSSMST influenced your professional goals?

SPM: Helping to establish and lead the Consortium for its first two years was a professional joy. It is always gratifying to help to bring a powerful idea to life when you believe that it will have significance and far reaching impact.

CL: NCSSSMST has allowed me to reach out and embrace the scientific culture of our country - meeting people who want to be involved in our future leadership— and will spend time doing it without thinking about the time needed to produce the program, product, etc.

JB: My involvement with the Consortium has influenced me professionally because it gave me a comparable group to interact with as I have executed our mission, being a catalyst for educational improvement in science, mathematics and technology in North Carolina and the nation. The Consortium was a very valuable resource for me when I came to NCSSM - the annual Professional Conference gave me an opportunity

to network with peer professionals who work at schools, which, in many cases, are a short step from, if not at, a college level.

BS: My involvement with NCSSSMST has given me many opportunities I would never had had such as working with a tremendous number of dedicated educational professionals, given me insight into the myriad differences in schools and students across the nation, and provided me opportunities to develop materials and projects to improve math, science and technology education across the United States. I still desire to work on related projects and develop new magnet schools.

DL: My involvement with the people and programs of the Consortium inspires me tremendously. I am always charged up after a conference or meeting. I find the creativity, skill and enthusiasm of Consortium folks to be very exciting. Personally, I enjoy some great, great friendships with my Consortium colleagues.

RL: As a brand new administrator of a specialized school (having not administrated before), I realized the importance of "consorting" with people who were planning and doing what I was hired to do. Simply said, my NCSSSMST experience has been the centerpiece of my professional growth and life as a specialized school administrator. I am proud to continue my involvement with NCSSSMST into my retirement.

JH: Professionally, I have grown along with the organization. I have a much clearer picture of what I need to do as an educator and administrator for the future of my school. I have learned a great deal from the other directors on the Board and from members of the organization. I have developed an even stronger belief in the work that I do because of my association with NCSSSMST.

Q: What is your best NCSSSMST memory or the achievement you are most proud of?

SPM: I have two. The first was welcoming the delegates and convening our first Consortium conference in 1988. It was thrilling to see that we were indeed real and that people believed in us

enough to actually show up! The second was IMSA's hosting of the 2000 NCSSSMST conference with the theme, "Liberating Goodness and Genius." We had two phenomenal keynote speakers who helped us to soar. Robert Galvin, Chairman of Motorola, delivered a spectacular address on our theme, and Benjamin Zander, Conductor of the Boston Symphony, led us in our afternoon of "possibility thinking." It was a fantastic launch into the new Millennium!

CL: During my tenure as President, I was able to establish the annual Research Symposium. The first year at Carnegie Mellon University is a special memory for me — Robotics Scientist Red Whitaker was a dinner keynote. We ate on white linen tablecloths within his lab with the robots all around us! One of the group's robots was part of the NASA MARS project. It is still a highlight of my year to go and see the students' posters and hear their presentations.

JB: My highlight is my involvement with Increasing Underrepresented Populations in NCSSSMST Schools project: being involved in discussions and programs regarding the Sloan Foundation grant; participating in presentations on the Sloan Programs at Professional Conferences; helping facilitate a Summer Institute at North Carolina Central University where a Strategic Plan for the recruitment and retention of underrepresented students in NCSSSMST schools was developed; hosting at NCSSM the first Sloan Student Summer Program - July 2003; obtaining continuation funds for the second Sloan Student Summer Program July 8-15, 2005; and obtaining funding from Siemens Foundation 2006 for a third Siemens Student Summer Program at NCSSM for middle school students from North Carolina, South Carolina and Arkansas.

BS: My best NCSSSMST memory is probably the writing and development of the 2001 Sloan Foundation Grant to improve minority student recruitment, retention and academic success in member schools. The subsequent workshops and summer programs over the years have improved the number of minority students in our schools as

well as improving retention and academic success. My second best memory was serving as host of the 1999 Professional Conference in Austin and the development of the Curricula Book in 1999 that proved very popular and is something the Board should consider updating in the near future.

DL: Wow, I could make a list. After a Board of Directors meeting in Arizona, several of us had stayed an extra day to take in the sights. Dottie Martin, Marty Shapiro and I, now all past presidents, and Larry Walker, a former Board member, had lunch together in Sedona. We began to map out plans to take the Consortium to the “next level,” building on the earlier work of leadership and moving to our next round of strategic planning. It was a wonderful, spontaneous session in a beautiful place. Many of our ideas developed in subsequent planning sessions have become a reality. Another cool experience as President was to welcome our members to the 2004 Professional Conference. Our setting was the Rose Center at the American Museum of Natural History in New York City.

RL: I am pleased with what I called my “transitional” presidential year (I was the last of the one-year term presidents). We got the web site up and laid the foundation for what we called the “professionalization” of the organization – with budget, bylaws, and an executive director.

Two kinds of memories, one generic and one specific. The general memory is the special feeling

I get recalling the many, many hours of discussions (in many, many venues!) with other professionals about what their schools and students are like, what they are doing, and how they are meeting the challenges of being involved in a specialized school. I learned so much from so many – I’d like to say THANKS!

I am most proud, however, of the 1998 Student Conference that we hosted at my school in Conroe ISD, Texas: *The World in 2020 – Transition to Sustainability*. Our team created the model for the kind of interactive student conferences that have been held since then and also the model using role-playing and the Internet that is key to the annual Keystone Policy Summits. I know I share memories with all the school people who have hosted Student Conferences – and that is when the last of the students and chaperones has departed and you can relax knowing it was successful and is over - the relief, pride, and exhaustion from a job well done!

JH: I can name three that stand out: putting together a format for the professional conferences that has been easy to replicate; hiring an Executive Director (even if only part-time); and making it my platform to move NCSSSMST to the national level by supporting the formation of national partnerships. One other thing will always stay with me – sharing hotel rooms with Cheryl Lindeman - that woman can go on four hours of sleep! It’s like rooming with the Energizer Bunny.

Dr. Stephanie Pace Marshall is the Founding President and President Emerita of the Illinois Mathematics and Science Academy and was founding President of the NCSSSMST.

Dr. Cheryl Lindeman is the current NCSSSMST Executive Director and is Biology Instructor/Partnership Coordinator at the Central Virginia Governor’s School for Science and Technology.

Dr. Betty Stapp was principal of the Arkansas School for Mathematics and Science and also Director of the Science Academy of Austin, Texas at LBJ HS; she currently works as a private consultant.

Dr. Joan Barber is the Vice-Chancellor for Student Life at the North Carolina School of Science and Mathematics.

Dennis Lundgren is the Director of Instructional Technology and Media Services at the Berrien County, Michigan Intermediate School District.

Dr. Ron Laugen is the retired Headmaster at Conroe ISD, Texas Academy of Science and Technology and is NCSSSMST Program Coordinator.

Dr. Janet Hugo is the Director of the Arkansas School for Mathematics, Sciences and Arts.

Your IRB: Educating Students, Monitoring Student Research, and Safeguarding Students as Research Subjects

By Judy Scheppeler and Christopher Kolar, Illinois Mathematics & Science Academy

The purposes of this article are to inform you about the formation of your school's Institutional Review Board (IRB), to present examples of research that IRBs often encounter, to elevate awareness of human subjects research concerns for faculty and staff, and to discuss how emerging requirements for science competitions may affect schools, staff and students.

An Institutional Review Board is the group charged with the protection of human subjects that are part of research endeavors. Throughout history, there have been multiple and egregious atrocities visited by individuals on others ostensibly in the name of research. One needs only to think of Auschwitz, the Tuskegee syphilis study, and Stanley Milgram's obedience studies to elicit feelings and visions of the gross abuse of humans. While we probably feel that such abuses are at an end, it has only been through national and international mandates – in the not-too-distant past – that the Federal system of laws and practices has been put into place to ensure that human subjects are treated in an ethical manner. Abuse and unethical treatment of human subjects still occur, although infrequently. In this article, we raise these issues specifically as they apply to non-biomedical research, the type of research that you are most likely to encounter at the secondary school educational environment.

With respect to the common forms of research among Consortium schools, there are several scenarios for your institution and your IRB to consider. First, Consortium schools are often teaching motivated, gifted and talented students who are interested in math and science, and, in a few schools, students gifted and talented in the arts. Therefore, our students are frequently of interest to researchers who may want to conduct

educational research on them or on our institutions and teaching practices. Second, as specialized schools, we are required to demonstrate our value to our stakeholders. We keep ordinary student records and also maintain archival records and sometimes conduct studies on graduates. Third, and perhaps most importantly, as we teach our students research skills related to the varied career paths they may follow, we often require that they conduct research projects. Many then enter their projects in local, regional, national, and international competitions. Whether they do research with human subjects or go into a field in which they will be involved in other ways with humans, it is our job to lay the foundation for them to succeed.

Keep these three scenarios in mind as you determine the roles and responsibilities of your IRB. In the area of non-biomedical research, the type of research that most of us will be involved in, there are many gray areas. Your institution and IRB will need to grapple with students as researchers and students as research subjects. Our goal is to provide you with information and resources to assist you in working with your students and in this challenging area. Your goals are to protect your students, to serve as a role model for their behavior, and to assist them in being ethical researchers. Be aware that some human subjects research issues can still stymie even experts who work in the area of non-biomedical research and non-biomedical IRBs.

Protection of Human Subjects in Research Competitions

Science competitions in which Consortium students typically participate require that student research involving humans, as well as animals,

certain biological agents, hazardous chemicals and equipment, etc. be reviewed and approved *prior* to starting the project. Society for Science and the Public (formerly Science Service), the organization that sponsors the Intel Science Talent Search (STS) and the Intel International Science and Engineering Fair (ISEF), publishes very specific human subject and IRB rules, regulations, and guidelines, “developed to help student researchers adhere to the Federal regulations and to, therefore, protect the rights and welfare of both the research subjects and the student researcher.” This information, an informative PowerPoint presentation, and all required forms may be accessed at http://www.societyforscience.org/isef/about/rules_regulations.asp.

The Siemens Foundation, which sponsors the Siemens Math, Science, Technology Competition, also provides clear criteria for what constitutes research involving vertebrates and for the protection of human and animal subjects, with similar rules and forms. They, however, state clearly that “high school IRBs are not permitted.” Research with human subjects and animals may only be conducted in a registered institution or laboratory under mentor supervision and with appropriate documentation. This information may be accessed at <http://www.collegeboard.com/student/pay/scholarships-and-aid/45104.html#research>.

Obviously, then, you need to review the competition’s guidelines before your students begin their investigations. You would not want any student’s project disqualified from a competition based because of its non-compliance with guidelines for research on humans.

IRB at IMSA

More and more Consortium schools are requiring research projects before students graduate. Along with the growing emphasis on STEM education and scientifically valid research, our institutions are becoming more frequent participants in educational research as well. The remainder of this article will focus on how these emerging functions and requirements, beyond the needs of competitions, must be addressed by your

institution. We will use our work at the Illinois Mathematics and Science Academy (IMSA) as exemplars.

The IRB at the Illinois Mathematics and Science Academy (IMSA) is the Human and Animal Subjects Review Committee (HASRC). IMSA policy dictates that we follow federal guidelines for human subjects research, and it also extends the committee’s charge to animal use in research. Our HASRC policies are more extensive than federal guidelines for human subjects.

Definitions

Most definitions of significance to an IRB derive from Federal Code 45 CFR 46, also known as the Common Rule. It is important to consider that the language of human subject research includes many *terms of art*. We outline some of the more significant concepts here.

Institutional Review Board (IRB): An IRB is a committee of employees and community members that follow widely accepted ethical principles, legally binding federal regulations, and campus policies and practices to ensure the ethical and legal conduct of human subject and animal research.

Human Subject: A human subject is a living individual about whom an investigator conducting research obtains data through intervention or interaction with the individual, or obtains identifiable private information.

Research: Research is a systematic investigation, including research development, testing, and evaluation designed to develop or contribute to generalizable knowledge (Title 45, subpart 46.102.d).

The definition of research is worth further discussion and scrutiny, both about what research involving human subjects is and what it is not. There are two phrases, *systematic investigation* and *generalizable knowledge*, that are key to understanding the definition. Keep in mind, however, that even the experts find gray areas, and your institution’s policies may dictate

practices and responsibilities in the area of research that go beyond what the federal definition includes, as our policies do.

Systematic Investigation: One thing that differentiates research from casual observation is that it must be systematic. This means that the collection of data is done in deliberate fashion, planned in advance, and the methods and techniques are identified prior to the commencement of work. A good school example is a qualitative study in which the student plans a series of interviews with identified persons, along with an accompanying plan for analysis. This is different than reporting where formal data collection and analysis techniques are not employed.

Generalizable Knowledge: The Common Rule also clearly identifies generalizability as an important component of defined research. This means that the findings of the work might be applied usefully by another person or in another situation. This applies even to case studies, for it is assumed that the reader of the study will learn something important about the world or their own circumstances. The researcher does not have to foresee the ways in which others could generalize the research; it is simply that the IRB determines that the work may be generalized. In applying the rule at IMSA, we consider all activities that may lead to publication or to a public presentation (e.g. a conference), which extends the federal guidelines slightly.

Special Groups: The Office for Human Research Protections considers some groups of research subjects as vulnerable. They include neonates, pregnant women, prisoners, some elderly individuals, comatose patients, some cognitively impaired individuals, the economically disadvantaged, terminally ill individuals, and minors and children. It is important to note that minors are in this group, and in high school settings most of our research subjects will be under age eighteen, so we have a responsibility to carefully consider what research investigations are permitted in our institutions with our students as

the subjects. For this reason, we conduct at least an expedited review of these research proposals. Our students may be unduly coerced, or feel that they cannot refuse an adult's request. Similarly, employees of an institution can feel coerced by the employer, so in some cases could also be considered a special group.

History of the Guidelines for the Protection of Human Subjects

The topic of research ethics is charged with emotion and history. It is fraught with emotion partly because a researcher's livelihood, student's grade, and sometimes an institution's reputation may be dependent on the results. History plays an enormous role in how we view, conduct, and regulate research that involves humans and animals. In the past, even after intense social scrutiny, individuals have been subject to abuse as research subjects. Briefly described below are the generation of guidelines that have lead us to Title 45, Part 46 of the Code of Federal Regulations for the protection of human subjects (Amdur, 2002).

The Nuremberg Trials and the Nuremberg Code: Written in 1948 at the end of the Nuremberg trials that addressed the Nazi crimes against humanity that occurred during World War II, the Nuremberg Code delineates specific conditions for research to be conducted using humans as research subjects. They include:

- Subjects must be fully informed of the intent and purpose of the research.
- Subjects must voluntarily consent to participate in the research.
- Subjects may opt out of a study at any time, for any reason, without consequence.
- There must be a favorable risk/harm assessment of the research.

While the Nuremberg Code has had a significant impact upon how research with human subjects is conducted, other cases of unethical research on human subjects in the twentieth century have led to federal guidelines and regulation of research involving humans.

National Research Act/National Commission for the Protection of Human Subjects of Biomedical and Behavioral Research:

Congressional hearings determined that federal oversight was necessary in order to protect human subjects. The National Research Act of 1974 was passed and essentially created the modern Institutional Review Board system. Title 45, Part 46 of the Code of Federal Regulations (45 CFR 46) provides the federal regulations concerning research with human subjects. These regulations have been adopted by almost all federal agencies and 45 CFR 46 is referred to as the Common Rule. The Code can be found at <http://www.hhs.gov/ohrp/humansubjects/guidance/45cfr46.htm>

The Belmont Report: The National Research Act created the National Commission for Protection of Human Subjects of Biomedical and Behavioral Research, which ultimately issued the Belmont Report and its three guiding principles for ethical research with human subjects: 1) respect for persons, 2) beneficence, and 3) justice. These principles should guide the design of research studies involving humans and are used by IRBs to determine whether a study is ethically sound (National Commission for the Protection of Human Subjects of Biomedical and Behavioral Research).

Respect for persons means that people are treated as autonomous agents, and individuals who have diminished capacity are provided with special protection. Minors, individuals less than eighteen years of age, are considered to have diminished capacity because of both legal standing and experience. The IRB must find that the following requirements are met:

- Research subjects must voluntarily consent to participate; minors should assent;
- Informed consent will be obtained; and
- The privacy and confidentiality of the research subject is protected.

Beneficence means that individuals are treated as you would have them treat you. The IRB must find that the following requirements are met:

- The research is designed so that risks to the individual are minimized;

- Any risks of the research are justified by potential benefits to the individual and/or to society; and
- There is no conflict of interest by the researcher.

Justice means that any potential risks and benefits of the research are equitably distributed among all individuals who may benefit from the research. The IRB must find that the following requirements are met:

- Vulnerable subjects may not be targeted because they are easy to gain access to; and
- Individuals who are likely to benefit are not excluded from participating in the research.

What Kind of IRB Does Your School Need?

The above discussion outlines some of the ways in which the relationship between research and research subjects have been framed, and the treatments promulgated on or by your students leads to the question of the role of an IRB in your institution. Consider the following questions when determining what kind of an Institutional Review Board you need to establish. While the answers to these questions may be straightforward, the process of establishing your own IRB may be less so.

- Do your students enter IRB-regulated research competitions?
- Is anyone (students, staff, external parties) conducting research at your institution?
- Does anyone have or plan to obtain federal grants?
- Does your institution have assessment initiatives where the individuals being assessed can be identified, directly or indirectly (e.g., name, school ID)?
- Do you have a research office, or other entity, that has a data warehouse that contains information where the individuals being assessed can be identified directly or indirectly?
- Does your institution conduct surveys in which students or other subjects can be directly identified?
- Does your institution conduct assessments on special populations (for example, minors, adult education students, English as a second language students, developmentally disabled)?

If your answer is yes to any or all of these questions, you have several choices to consider. You may ignore the establishment of an IRB because the research is low risk or occurs in very rare situations. You may establish an IRB related to competitions based on their published rules. Or you may form what we will call a comprehensive IRB. In many cases, your district's mandate, your institution's policies, and/or other guidelines may have already dictated to you that you must form a comprehensive IRB.

Establishing a Comprehensive IRB Committee

There are many factors to consider when establishing a comprehensive IRB. The Office for Human Research Protections (OHRP) is the federal agency charged with overseeing human subjects research. Their web site contains the guidelines for establishing an IRB: <http://www.hhs.gov/ohrp/humansubjects/guidance/45cfr46.htm>

Under federal guidelines, your comprehensive IRB must have a minimum of five individuals, including one person who does not have, or has not had, an affiliation with your institution. There needs to be at least one member who is a non-scientist and one member must be someone knowledgeable about the population of subjects that you will be dealing with. You may have more than five individuals, but depending on the size of your institution and the number of proposals that you will need to process each year, it may be most efficient to keep the committee small.

Your IRB must have written policies and procedures. We suggest that you look at the policies and procedures of institutions like your own to begin establishing these. Googling "Institutional Review Board," visiting the IMSA HASRC web site at <https://www3.imsa.edu/learning/inquiry/irb>, or going to a local college's research office web site will provide you with examples of other organizations' IRB policies and procedures.

Your IRB must meet at least once each year and most likely is subject to an *Open Meetings Act*. You will need to establish a regular meeting

schedule, to post that schedule at a specific time prior to the meetings, and to post each meeting's agenda. You must also keep minutes of the proceedings of each meeting.

Include professional development at your IRB meetings. There are many published papers that deal with *mission creep*, non-biomedical research, and other pertinent topics. It is worth the time and effort to review one of these at each IRB meeting. The area of non-biomedical research is fraught with gray areas, so reviewing what the experts are discussing helps keep your committee grounded and focused on its mission. As members become aware of IRB issues, it is easy for them to become increasingly protective, proscriptive, and begin to develop a negative, authoritarian image within your institution. Regular discussions about articles among board members will help this form of mission creep from setting in and keep your board focused on protection of human subjects, though it is tempting (and easy) to digress into commentary on research questions and issues not related to the review (Oakes, 2002; Pritchard, 2001; UIUC Center for Advanced Study; Roberts, Geppert, Coverdale, Louie, & Edenharder, 2005).

Your IRB's Role in Student Research

Once you have established an IRB, you must decide how you are going to review and monitor the work that your students conduct both on and off campus. Suppose your students are conducting research as part of a class to learn about the process, such as by collecting survey data. This is strictly an educational activity, not requiring IRB review. However, this does not mean that students should not be conducting research in an ethical manner. This is an appropriate time to introduce the IRB to your students and to discuss the process. The historical cases of human subject abuse and other case studies can serve to generate discussion. Students should follow the established practices of providing information to potential subjects, obtaining informed consent (a verbal consent in most classroom situations would suffice), allowing students to opt out of participation, and ensuring the anonymity of the participants.

Students should also address research ethics as part of learning about survey design and research with human subjects (Thomas, Goudie, & Shapiro, 2004). Our IMSA IRB (HASRC) has developed written materials for our research course, and occasionally HASRC members participate in classroom discussions about the topic. Students may select topics that could cause other students psychological distress (see risks and harms below), so it is important that the course instructor review student investigations and avoid those that may be harmful.

If your students are conducting research on-campus or off-campus as part of a research program, you may be tempted to call these investigations educational activities and consider them exempt from requiring IRB review (Pospisil, 2004). We have chosen not to do this, your institution's policies may not allow it, and the research competitions that your students may want to participate in may require an IRB. Also consider whether your students may want to present or publish their investigation, such as in the *NCSSMST Journal* - most journals or conferences require that the work have been approved by an IRB.

Also consider your students' research subjects. Often they are minor students at your school and you have a responsibility to ensure that they are treated in an ethical manner. By monitoring what students do at your institution you can also ensure that the burden on individuals and your institution does not become too great. Students can suffer from *survey fatigue*, especially if the surveys are poorly constructed, and then not take seriously the institutional research surveys that you need them to complete.

It is important that the IRB proposal process be thorough but not burdensome on your students. It is especially important that they understand the purpose behind the rigorous IRB protocol. We use the items in Figure 1 to guide the content of the proposal. Students who have written a thorough research proposal can probably complete the IRB proposal in two to three pages (not including surveys or consents), and without a lot of additional time. We consider this a good learning experience for students as they are getting ready

to conduct their own investigation. Our IRB chair generally works with students as they write their IRB proposal and reviews it before submitting it to the committee for expedited review. Our research office staff is also very involved in assisting students with developing surveys, writing consent forms, collecting survey data on-line, and data analysis.

What about students who are working off-campus in businesses or research laboratories using humans or animals? We require that the student obtain and turn in a copy of that business or laboratory IRB (or animal care committee) approval letter. Your IRB has no jurisdiction over what an investigator is doing at another institution as long as it does not involve research using your students as subjects or is not conducted on the premises of your institution. You want to ensure, however, that your students are part of research that is being conducted by established practices and in an ethical manner. Having students obtain a copy of the researcher's approval letter provides an opportunity to teach your students about proper practices in research as they participate in it. We have not had any researcher object to providing this information to a student for inclusion in his or her research proposal. These investigations are all briefly documented in our IRB minutes.

Student Research Case Studies

Our IMSA HASRC reviews fifteen to twenty research proposals each year from students working on-campus, from external researchers who want to use our students or classrooms in their own research, or from our own staff members. Each year there are also one or two proposals from students working off-campus with a researcher that wants to conduct a study on-campus with students or staff members as research subjects. Nearly one-third of the one hundred and fifty students who work off-campus each year will conduct chart reviews, use samples obtained from humans, work with patients, collect data in psychological venues, or participate in research that uses animals – activities which must be reviewed by their respective host institutions.

Students are most engaged in learning when they

can ask their own questions, especially when that question relates to something with which they have personal experience. Below are brief descriptions of typical investigation topics from students that were considered by our HASRC. Following the examples are the types of questions raised by the studies.

PTC Tasting: The ability to taste PTC has different frequencies in different populations, and may be associated with likes and dislikes of various foods, such as broccoli or coffee. We frequently use this in our Methods of Scientific Inquiry course: students can design their own mini-investigation based on PTC tasting. Some students have found literature that suggests that PTC tasting may be associated with a family history of depression (Tepper, 1998). Because this information may impact students regardless of whether they are aware or unaware of such familial health issues, the HASRC ensures that researchers have a plan to deal with this data and student confidentiality.

Left-handedness at IMSA. It has been suggested that individuals who are left-handed are better at math than those who are right-handed, and that women who are left-handed have an increased risk for breast cancer. Your student wants to correlate SAT test scores with handedness.

Teasing: Students react differently to bullying and teasing. There is extensive psychological research in this area. One of your students would like to explore the social characteristics and personality types of students and how they have reacted to being teased when they were younger.

Music and Memory: Much research has been conducted on the effects of music on memory, blood pressure, heart rate, and so forth. Today most students are found walking around and even studying with their iPod. You have a student who would like to determine which types of music affect memory.

Potato Chip Study: Students asked the HASRC to approve a study that measures student snacking while watching television. The research outlines using two different types of potato chips and the

HASRC asked about the nature of the differences in the chips. Students replied that they were just ordinary chips that they would be receiving from their off-campus advisor, the director of a taste and smell institute. Attempts to reach the mentor for clarification failed but HASRC members found on the institute web site advertisements for a food additive that allowed users to “lose weight” while snacking and watching TV.

Social Groups: Prior to community day (an on-campus student research conference) the HASRC was notified of a presentation to be given on student social groups that had not been reviewed by the HASRC. The research consisted of observing students around the school and residential areas of the academy, classifying the students (e.g., jock, chess team member, cheerleader, nerd, druggie, student council member), and then developing social network maps of students observed speaking to one another. Because the classifications involved groups whose members are widely known, or that could have been potentially hurtful, and because the observations involved personal conversations at times when student participants would have reasonably expected privacy, the HASRC prevented the research from being presented.

Case Study Questions

The above are only a few examples of the types of proposals that our HASRC faces every year. The IRB proposal in Figure 1 is an important first step in enabling your IRB to begin to address the issues related to research proposals, including:

- Are the investigations permissible for students to conduct?
- What would your IRB want to consider when determining whether to approve a specific student investigation about the above topics? For example, would informed consent be required?
- How might the investigator minimize psychological distress?
- Are there conditions under which any of these studies would not be allowed? What are the conditions under which you would allow these studies to occur?

Biomedical versus Non-biomedical Research and Definition of Risk

While the risks and harms to individuals seem straightforward when the research is biomedical, non-biomedical research presents huge challenges in determining risk and harm to individuals. Risks and harms include inconvenience, physical harm, psychological harm, social harm, economical harm, and legal harm. The American Educational Research Association (<http://www.aera.org>) has a working group that has detailed these harms in relation to non-biomedical research and the ways that they can be prevented. Their web site and white papers in this area are valuable reading.

Psychological harm, which is of great concern in non-biomedical research, is challenging to predict and prevent. It is especially challenging in our typical population of research subjects – teenagers. One does not know what personal question will spark a serious reaction or memory in one student, but not in another. We have chosen not to avoid these subjects and instead carefully review the proposal. We often require informed consent and that data collection take place when a skilled staff member is available to counsel students or ensure that students seek assistance from one of our counselors if they are distressed by the questions. And there are some research questions that we do not allow students to pursue.

Your IRB's Role in Protecting your Students as Research Subjects

In addition to working with students to ensure ethical conduct during their own investigations, there are many instances requiring the oversight of the IRB for cases related to the use of institutional data, student records, or direct student participation.

Institutional Research: Institutional research refers to the practice of collecting and maintaining data to demonstrate the effectiveness of institutional programs. This includes not only traditional student records, but may include information collected for the purposes of demonstrating fulfillment of your institutional mission.

It is important that you not only have a good

sense of the records kept by your institution, but also that you develop written policies for their custodianship, use, and eventual destruction. In most cases there are clear state laws or policies dictating how long student records are kept and who may access the records. One of the key points of the definition of a research subject is related to identifiability, so whenever possible names and other identifying information should be removed from data for long term storage. Maintenance and use of this data is also subject to the Family Educational Rights and Privacy Act (FERPA), a federal law that protects the privacy of student educational records.

Teacher Research and Action Research:

It is very common for teachers and administrators who are seeking advanced degrees to engage in classroom research activities that utilize their students. It is important to note that, while these are classroom activities with respect to the teacher being the learner and may be exempt in terms of their university IRB, the involvement of students on your campus puts these activities under your purview. Your faculty and administration should be aware that the use of their classrooms or students means that the work should be reviewed by your IRB. It may be that the IRB determines the work does not fall into the category of generalizable results, though the issue of dissemination should also be carefully considered since IRB approval is required unless there are no plans for dissemination that may compromise student identities.

Your institution may also need to review existing policies regarding research consent. As a laboratory school, all IMSA students sign a consent form indicating that portions of their student records may be confidentially used for research purposes. As with teacher action research, the IRB will consider whether the research is simply meant to be used in-house, as traditional action research, or if the possibility exists that the staff member may eventually wish to publish or present the results.

External Research: Working in a school with a special population, it is likely that you will be

asked to make your students available as research subjects by a researcher external to your institution. Again, because you are working with a special group of subjects, this type of research should always be reviewed by your IRB. We have often received pressure from a researcher who believes that their project is exempt from IRB review because of minimal risk. The single most important rule that your IRB members can learn is that exemption is determined by the IRB, not the researcher. Nobody can ever tell the IRB that his or her research is exempt, period.

When working with external researchers it is also important to consider jurisdiction. An IRB has sole authority on its campus. External researchers may have already approached their own IRB, but the board at hypothetical University X can only provide conditional permission for the researcher to do work on behalf of the institution. The review undertaken by your school IRB issues the binding ruling about any work conducted on your campus and with your students.

Retroactive Review

As mentioned in the institutional research section, institutional data collected on students in the past remains subject to IRB review and oversight. One of the most common problems that the IRB experiences is when a student or staff member begins conducting research and only later approaches the IRB for a retroactive review. An IRB must be prepared to respond to the statement "I wasn't planning on presenting it when I collected the data, but now that I see the results I want to. I am free to use existing data, right?" As difficult as the conversation may be, this is operationally an unintentional (or intentional) means of circumventing the IRB. It is important for staff and students to understand that if they think that they might some day want to present or publish work derived from the data, the data needs to be collected from the beginning with IRB approval.

There may be a difficult day when you will have to end a student or staff research project because of IRB violations. Existing institutional data collection is done with established policies guiding its use

and the protection of students. It is important that the IRB process become part of your institutional culture and an expected early step when planning a research effort.

In Conclusion

Establishing your own IRB protects your students and also protects your institution. It is an excellent way for you to model professional behavior with your students. IMSA and its HASRC have decided to embrace all forms of student research as well as research using our students as subjects, providing that the investigations can be conducted in an ethical manner and that students are kept in as safe an environment as we can maintain. Some institutions choose not to allow students to conduct surveys as part of research investigations. There can be good reasons for this, including not having the ability to monitor these effectively or not being able to provide counseling services if required. Student generated questions can be valuable for your institution, and since students own their own questions, these investigations are generally very meaningful to the student and the students are highly engaged.

How to Learn More

There are many excellent resources available about establishing an IRB, the use of human subjects in research, and the various gray areas of non-biomedical research. Following are just a few that we recommend for both experienced individuals and novices to this field.

- Additional historical cases as well as questions to use with students: <https://www3.imsa.edu/learning/inquiry/irb>
- Dept. of Health and Human Services – Office for Human Research Protections (OHRP): <http://www.hhs.gov/ohrp/>
- OHRP IRB guidebook: http://www.hhs.gov/ohrp/irb/irb_guidebook.htm
- American Educational Research Association (AERA): <http://www.aera.net/>
- AERA: Social and Behavioral Sciences Working Group on Human Research Protections: <http://www.aera.net/humansubjects/risk-harm.pdf>

- IRB Forum: <http://www.irbforum.com>
- International Science and Engineering Fair
human subjects documents: <http://www.societyforscience.org/sts/intfrm.pdf>
- Siemens criteria for live subjects:
<http://www.collegeboard.com/student/pay/scholarships-and-aid/45104.html>

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Acknowledgements

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Judy Scheppler is coordinator of student inquiry and research at IMSA, a position she has held since 1998. She has served on IMSA's IRB, the Human and Animal Subjects Review Committee (HASRC) the entire time, and has been the HASRC chair for the past five years. Christopher Kolar is coordinator of research and evaluation at the IMSA, a position he has had since 2004. He has served on the HASRC for four years, and is currently on the Board of Directors of the National Consortium for Specialized Secondary Schools of Mathematics, Science, and Technology, where he serves on the research committee.

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"Prior to 1988, communication among the many specialized schools was mostly informal. Four such schools - The North Carolina School of Science and Mathematics, Thomas Jefferson High School for Science and Technology, Louisiana School for Math, Science and the Arts, and the Illinois Mathematics and Science Academy - sought to create a formal alliance among these schools. They planned an organizational meeting from the spring of 1988 to be held at Thomas Jefferson High School in Fairfax County, VA. The directors of the schools contacted all of known similar programs and invited them to send representatives."

- from *Shaping Leadership for the 21st Century* (1991),
edited by Michael Haney, Ph.D., former NCSSSMST President



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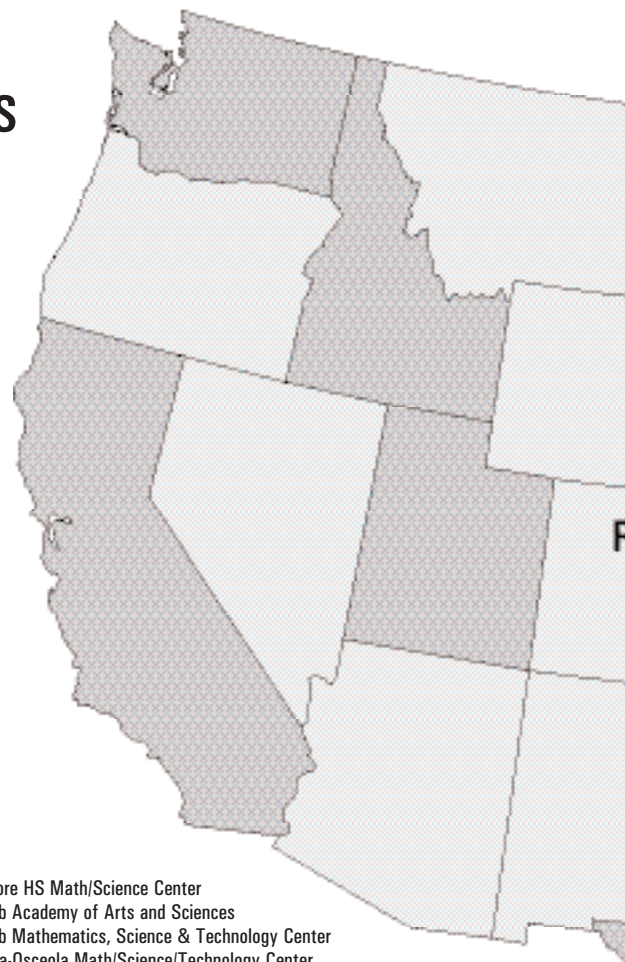
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- To publish feature articles related to innovation in secondary mathematics and science education. Topics may include interdisciplinary curriculum; implementation of reform standards; infusion of technology into curriculum; creation of student centered active learning environments; original research of mathematics and science pedagogy; theoretical or conceptual positions; connections between science, mathematics, technology and society; connections between research and practice; discussion of current issues in mathematics and science education; and development of community and higher education partnerships. See feature article summaries on web site.
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Photographs Photographs are encouraged and welcomed if they are relevant and support the content of the article. Print quality must be a minimum resolution of 300 dpi.

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- ☐ Cover page
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About NCSSSMST

The National Consortium for Specialized Secondary Schools of Mathematics, Science & Technology (NCSSSMST) was established in 1985 to serve educators and students in the growing number of specialized high schools throughout the United States. NCSSSMST is a forum and clearinghouse for the exchange of information and program ideas among faculty, staff, and students from member schools and affiliated organizations.

The Consortium comprises a network of research and development secondary schools with strong college and university affiliate members. As of June 2008, the 100 member schools and centers located in 30 states enroll more than 37,000 students. Each member school addresses specific needs of its area, and most serve districts or states, depending on their charter. Two associate institutions are in the process of developing new schools. Over 90 colleges and universities are members and participate in program-related activities or sponsor special events.

Brief History Seeking to increase communication among the mathematics, science, and technology specialized schools, four such schools—the North Carolina School of Science and Mathematics, the Thomas Jefferson High School for Science and Technology (VA), the Louisiana School for Math, Science and the Arts, and the Illinois Mathematics and Science Academy—hosted an organizational meeting in the spring of 1985. Representatives from 15 schools attended, and NCSSSMST was founded to foster growth and interaction among similar programs.

Governance NCSSSMST is a nonprofit organization with IRS 501(C) (3) tax-exempt status and is incorporated as a non-stock corporation in the Commonwealth of Virginia. The Board of Directors, composed of leadership from institutional members, meets at least four times a year to establish policy and set direction. The fiscal year is July 1 through June 30. NCSSSMST has implemented a strategic plan, and the board serves as the strategic planning team. The institutional membership elects the Board of Directors and officers of the corporation for three-year terms. The Board employs an Assistant to the President to handle day-to-day business.

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