

“Loving the World and Our Children Enough—Nurturing “Decidedly Different” Scientific Minds, by Design”
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Thank you, Jan, and good morning. What a fantastic and powerful day we had yesterday. It’s such a joy to be with kindred spirits.

In her essay, “The Crisis in Education” (1958), Hannah Arendt wrote: “Education is the point at which we decide whether we love the world enough to assume responsibility for it...And education, too, is where we decide whether we love our children enough not to expel them from our world... nor to strike from their hands their chance of undertaking something unforeseen by us, but to prepare them in advance for the task of renewing a common world.”

Jan framed our Colloquium around building a “new” scientific mind—a mind that consciously reasons and behaves its way into creating a sustained constructive human presence on the earth. This presence is not only manifested by “scientific and social literacy, but by ecological integrity, economic vitality and social equity” (United Nations Educational, Scientific and Cultural Organization, 2005).

As an educator, this grounds my work in a social and cognitive context of generative and restorative learning—in wholeness, interconnections, stewardship and life-affirming design, and it creates the imperative to love our children enough that we ignite and nurture what I’m calling “decidedly different,” “both/and” scientific minds prepared for the task of renewing a common world” (Arendt).

What does a child look like who is part of a new generation of earth and world citizens? He looks like the ten-year-old boy, who wrote to a colleague of mine—the manager of Club Penguin’s “Kids Helping Kids” Program. Here’s what he wrote: “Dear Club Penguin, I was not able to donate coins to the coins for change charity. I would like to help, but I don’t know how. I want to save the polar bears and children who can’t go to a doctor. I also want to help villages in Africa who don’t have enough water. I know how to change the economy but no one will listen. Most of the problem is cars and gas. If we used electric cars or vegetable oil, the economy would be much better. You see hot gasses melt the ice, endangering polar bears and other animals. I’m just a kid 10 yrs old, but I really, really want to help” (personal correspondence).

This new generation also looks like Alec Looz, a young man from California, who, when he was 12 saw the film *An Inconvenient Truth* and changed his life (Guggenheim). He founded the not-for-profit Kids Vs Global Warming, met with political leaders and started speaking at high schools. He’s talked to over 100,000 kids. Alec is now 16 and he wants everyone to “live as if the future matters.” He’s created a youth-led campaign called iMatter because he wants to start a cultural revolution. Why is Alec so passionate about this? “Because,” he says, “this is bigger than light bulbs or laws or energy sources. This revolution has to transform the hardest thing of all—the way we think” (Cavoukian).

As human beings, we walk in the direction of our questions. My work is framed by a singular one: “What will it take to create a generative and life-affirming system of learning and schooling that liberates the goodness and genius of each child, and ignites and nurtures the power and creativity of the human spirit for the world?” (Marshall, 2006, xvi). For the Illinois Mathematics and Science Academy, (for which I am privileged to be the founding president and now president emerita), this question and its commitment to be “for the world,” emerged as a statement of identity—“to ignite and nurture creative, ethical scientific minds that advance the human condition” (IMSA Mission in Marshall, 2006, 16).

My answer to this question of what it will take is straight forward. I believe it will take a radical new story, new map and new landscape for nurturing “decidedly different” “integral and wise” scientific minds. I hold what I’d call a “cascading heuristic”—a mantra of sorts—grounded in multiple premises:

- Mind-shaping is world-shaping.
- When we change the story, we change the map.



- When we change the map, we change the landscape.
- When we change the landscape, we change our experiences and our choices.
- When we change our experiences and choices, we can change our mind.
- And when we change our mind, we can change the world.

This is the revolution that 16-year-old Alec is enrolling us in—transforming the hardest thing of all—the way we think! My comments will name and hopefully illuminate several fundamental ideas—all grounded in our collective need to engage in three actions:

First, tell and live a new story—a new cultural narrative and a new paradigm of the 21st Century scientific mind—what it “looks like”; how it thinks, belongs to, and makes sense of the world; what it pays attention to and why, and how it embodies a living systems and ecological world view. Second, name design principles and a new map for creating systems and environments for developing this “new” mind. Third, create personalized child-honoring learning landscapes where children explore, inquire, imagine, create and dream, by day.

We’ll focus on the first two ideas—the new narrative and map, then in the workshop use them as contexts for designing new learning landscapes. Like you, I come here as an inquirer and an explorer. My comments are not about answers, remedies or fixes. They are about new questions, paradigms and possibilities. They are about telling new stories, designing new maps, and creating new landscapes for nurturing *decidedly different* scientific minds that are knowledgeable, creative, and morally awake and that can advance not only the new STEM frontier, but the human future and the health of the biosphere.

I begin with the NEW STORY for three reasons. First, because the power of story to crystallize an idea, mobilize behavior and create momentum for massive social change (what we are talking about) is asymmetrical and disproportionate to the actual information it provides. Second, because we manifest our stories in everything we think, say and do; we not only belong to the world through the stories we tell, but we actually become them. When we don’t know the narratives defining us we lose our choices; and when we lose our choices, we lose our capacity to shape our minds, lives and world with intention and purpose. Third, when we change the story, we change the map.

The Institute for Noetic Sciences in California is working on a powerful “story” project for high school students called Seeds of Change, this “Worldview Literacy Project” is designed to “help students discover and create an expanded view of reality that can empower them to appreciate multiple perspectives and ways of knowing.”

Here’s how they describe the project: “Each of us has a story about the nature of reality, or a worldview. Our conceptual framework and set of beliefs, informs our goals and desires, and shapes our behavior and values but rarely do we understand its impact or question how it is acquired. How and why we create a narrative about who we are ... are left largely unaddressed by the educational system, and yet they are at the heart of our ability to thrive in a hypermodern world... Students must understand themselves as authors, not simply of their own story, but also of our global narrative” (“Institute of noetic,” 2011).

We unconsciously manifest our worldview—our story of how the world works and how we come to know it—in the structures, processes and even purposes of our institutions, especially our schools—and in how we teach and ask our children to learn. What’s so fundamental to our work is that every worldview, has an inherent cognitive understory—an embedded epistemology or way of knowing, that not only serves as a lens through which we see and create our world, but also tells us how knowledge is constructed and derived and the source of its authority.

So, what is the West’s prevailing worldview paradigm? According to historian and philosopher Richard Tarnas, “The West has moved through three major phases in its 2,000 year history, in which distinct overarching worldviews prevailed.”



First, the Classical World View—the Age of Gods and Oracles (dominated by a belief that knowledge was delivered from the Gods through oracles and meaning was “bestowed”); second, the Pre-Modern (Medieval) World View—the Age of Faith and Superstition (dominated by the belief that knowledge was derived from authority and meaning was derived from relationships); third, the Modern Worldview—Age of Reason, Empiricism and Science (Schlitz, 16). This is the Age of reduction, parts, analysis, individualism and mechanical causality where meaning is held by the human mind and projected onto nature.

It is from this worldview, that the paradigm of dualism and scientific empiricism emerged. This is where we are now and one of the ways it plays out in the United States is in our obsession with fixing “broken” systems”: healthcare, the auto industry, the banks, the financial system and of course “broken” schools. When you believe in mechanical causality, from a cognitive perspective, this “fixing” mindset actually makes sense. Mechanical systems are closed, often complicated systems, and they have independent parts; they can be fixed.

But, human systems cannot. There are very few parts. The system is more complex and open and there are lots of variables and causal connections. The whole and relationships are all there is. Human systems are not broken or in need of fixing; they are often wounded and in need of re-weaving and healing; and they need to be re-designed. Simply, we get what we design for and design principles are fundamentally rooted in and derived from our worldview. When we use reductive and linear thinking to solve complex, interdependent human problems, we only exacerbate them. I believe this is precisely where we are in the development of scientific minds.

What’s so critical to our work is that every world view has a cognitive paradigm that creates a coherent but not necessarily “correct” picture of reality. This framework enables the world as it is currently known, to be understood and navigated; but it also restricts, marginalizes or even punishes all the other ways we construct knowledge because they threaten the safety and security of tradition and convention.

We see this played out everyday, in unconscious, yet tenacious manifestations of linear causality that have calcified into unquestioned modes of thinking and design that shape every dimension of our lives. And nowhere is the imprint more debilitating and toxic than in the processes and structures of schooling, and what, how and why we ask children to learn. And, here’s the “tragic irony”—science has change its mind about how the world works.

A new worldview is emerging. The natural world is now seen as a living web of relationships, connections and potentials—inherently whole, abundant, creative and self-organizing. As Tarnas notes, “the Western Mind appears to be undergoing an epochal transformation...we can participate intelligently in that transformation only to the extent to which we are historically informed.” He calls this profoundly transformational time “the unnamed phase” (Schlitz, 16). What this phase ultimately named will be important because what we call it, will become what it is. I believe part of our work now is to help navigate the time and space between world views, by design—by creating conditions for our children to live into this new emerging paradigm now and experience its wholeness.

So what does this worldview and “emerging new story” of ecological interdependence, human potential and consciousness have to do with us as we seek to ignite and nurture scientific minds able to create a sustained constructive human presence on the Earth? Quite simply everything. Because when we change paradigms, we change maps; we change epistemologies and ways of knowing; we change language and how we think about who we are, how we belong, and what is possible. We ask different questions; we solve different problems; and we solve current problems differently. “We are what we think” said the Buddha. “All that we are arises with our thoughts. With our thoughts we make the world” (Schlitz, 49).

My hope is that together we: catalyze a new global conversation about the nature of 21st Century scientific minds; create a new lexicon; and reimagine and redesign the contexts and conditions of learning for wise world-shaping.



I begin my remarks with a fundamental premise: “Decidedly different” “both/and minds” are essential for a sustainable future. Why? Because mind-shaping is world-shaping and impoverished thinking has led to impoverished problem-solving and world-shaping. Wise world-shaping requires that we and our children think in *decidedly different*, integral and wise ways.

For me, this transformation is not only a shift in worldview but a fundamental shift in consciousness. *It won't come from reinventing social structures and institutions, although that will happen. It won't emerge by reforming policies and practices, although they too will change. Rather, I believe it will come from an altering of mind and the emergence of integral and wise global minds that will creatively live into a new worldview of an interconnected living planet and a sustainable and interdependent human family. I believe that the fullness of our humanity and the sustainability of our planet rest with the...nurturing of decidedly different minds”* (Marshall, 2006).

The Institute for Noetic Sciences says it powerfully...” [there] is evidence of the crucial role that consciousness plays in any effort to advance toward a more globally sustainable and just civilization. Voting is good, but changing one’s mind and heart is better...reality follows the quality of our thoughts and beliefs, both conscious and unconscious... these are what drive the choices that cumulatively result in the world we live in. By changing those beliefs, we can change the future” (*The 2008 shift*, 14, 2008).

So, what do I mean by “decidedly different” “both/and” minds? I mean minds that discern wholeness, interconnections and system interdependencies (non-linear causality); notice, analyze, and integrate illusive patterns within vast amounts of unstructured multidisciplinary data; deftly and responsibly change course when hypotheses, and “proven” strategies fail; ethically and imaginatively engage with change and unravel and resolve complexity; seek consilience and restorative and compassionate solutions to conflict; embrace uncertainty, ambiguity and paradox; creatively generate new knowledge, questions, ideas and solutions; fluidly and innovatively navigate within, between and beyond multiple disciplines and mental models; and globally collaborate to wisely improve the human condition and sustain the health of our planet.

What makes these “decidedly different” minds, “both/and” is the ease and fluency with which they integrate multiple domains and access the power of “both/and” thinking: the power of the intellect *and* the imagination; the power of knowledge *and* relationships; the power of research and experimental design *and* prototyping, simulation, scenario building, and storytelling; the power of observation and evidence-based truth *and* improvisation and experiential truth; the power of analytical measurement *and* aesthetic insight; the power of observation *and* intuition; the power of reason *and* passion; the power of curiosity and skepticism *and* wonder and awe; and the power of expertise *and* wisdom and love (Marshall, 2006).

I have called these “decidedly different” minds, “both/and minds” because they integrate and validate all the ways we come to reason, create, make meaning, and represent and verify knowledge; they connect our interior (more perceptual, experiential, aesthetic and intuitive) ways of knowing with our exterior (more analytical, observational and objective) ways of knowing; they nurture life-affirming habits of heart and generative habits of mind; they cultivate the synergies that emerge from disciplinary convergences and their distinct organizing constructs, modes of inquiry, symbol systems; and they honor both the rigor of scientific thinking and the wisdom of indigenous thinking.

I believe the epistemology of our “unnamed phase” will be grounded in generativity, wholeness, interconnections, and integration—“both/and.” We are beginning to recognize that the reigning cognitive orthodoxy of reductionism, instrumentalism, fixing and zero-sum game is not working. Howard Gardner (1993) reinforces this “both/and” paradigm when he says: “In science, mathematics, and the arts, there is widespread recognition of the significant place occupied by intuition, unconscious promptings, inexplicable insights, and the sudden awareness of relationships. Scientific discovery and artistic creations are hardly the result solely of rational considerations” (p. 390).



I had the privilege of attending two gatherings with the Dalai Lama last year. He called us “to make a better human society.” To advance this, he challenged the Center for Investigating Healthy Minds (University of Wisconsin, Madison, Wisconsin) to study the neurological impact of sustained acts and thoughts of compassion, empathy, forgiveness and love on the brain using both the rigor of Western scientific inquiry and the ways of knowing of the contemplative traditions. What they are learning is dazzling but not surprising; these attributes actually strengthen the biological circuits in the brain that underlie them; through practice and experiential immersion, we can actually increase our capacity for compassion, empathy, altruism and forgiveness.

In a fascinating research article titled, “I To We: The Consciousness Transformation in Compassion and Altruism, the authors suggest that “altruism and compassion may arise as a natural consequence of experiences of interconnections and oneness, an altered world view, and a resulting shift in the sense of self and self in relation to others” (Vieten et al, 930).

This is an astonishing inheritance and it is what we must design for because our children have no idea that this is who they are and that their capacity for “making a better human society” resides in how they think, what they think about, and what they do with what they know. It resides in their capacity to “integrate intelligence and compassion,” which is how Wisdom University president Jim Garrison defines wisdom.

Our work now is to help them to do so, by design. This is the new story of learning for Sustainable Futures. It is about wholeness, integration, networks, and abundant potentials, not parts, silos, or “bits and pieces.” It is about engagement, connections, and co-creation, not transmission. It’s about multiple intelligences, not a single and fixed IQ. It’s about reason and compassion, inquiry and empathy, investigation and ethics, and it’s about innovation, imagination, and life-long, life wide, and life deep learning. It is about freedom, autonomy, purpose and meaning. It is about developing a new generation of earth and world citizens who mindfully weave together multiple contexts of knowing and in the words of Arnold Toynbee, “dare to think of the welfare of the human race as practical objectives.”

Before we leave the construct of multiple ways of knowing, I want to name two challenges as we design learning experiences for developing the new scientific mind. First, the dominance of analytical reasoning as the sole arbiter of truth, and second, the place of wonder, awe and even love in science. This level of integration goes by many names: synergistic convergence, consilience, “intellectual fusion” (Crow, 2002). Regardless of its name, Parker Palmer affirms its significance. “Every way of knowing becomes a way of living,” he said. “Every epistemology becomes an ethic. Every mode of education, no matter what its name, is a way of soul-making.”

The questions that hold the greatest challenge for mind making and that we must ask our children are not, “*What* did you learn in school today?” but rather, “*How* did you learn in school today, and *who* are you now?” Not *what* did we teach, but *how* did we teach, and *who* have you become as a result? How we teach and how we ask our children to know, will become how they live.

The disproportionate time and value placed on speed, and one size and one way fits all curriculum and assessment, have neglected and silenced our children's multiple potentials because we reward only two of our intelligences—logical-mathematical and linguistic—and marginalize others. In life, there are many ways to know and be smart, but not in school.

The Carnegie Foundation for the Advancement of Teaching, a highly respected higher education foundation in the United States, argues that when analytical thinking and content mastery become the sole objectives of higher education, “It threatens to create a culture of argument that is so skeptical and detached that it can become unmoored from the human purposes that rationality and rigor are meant to serve” (Colby, & Sullivan).

Our children cannot fully know or belong to the world until they trust, integrate and are recognized for all the ways they come to know—until scientific ways of knowing and indigenous ways of knowing are



connected, in the exploration of possibilities and in the pursuit of deepening truths. Over time, this pursuit leads every great scientist to establish a deep relationship with the subject he or she is striving to understand and even to love it. There are some great examples that illustrate this. My favorite is Barbara McClintock, arguably the greatest American biologist of the Century and the greatest American scientist in the 21st Century.

As a young woman, McClintock became fascinated with genetic transposition. And she wanted to know how genes moved and how they carried their messages from place to place. But, in her day, there were none of the instruments and procedures that we have now. There were only hunches, hypotheses, clues and the powers of the human imagination. McClintock engaged deeply in genetic science using these internal tools, but the price she paid was marginalization. Her work was distrusted; she could not get grants, she could not get articles published, until she won the Nobel Prize. And then, as they say, her dance card started filling-up.

Another scientist, Evelyn Fox Keller, told McClintock that she wanted to write her intellectual biography so she asked McClintock, *how do you do great science?* Here's what Barbara McClintock said; now remember—here's woman who was one of the most precise empirical observers and logical thinkers in American science--and she thought for a moment and said, "about the only thing I can tell you about the doing of great science, is that you somehow have to have a feeling for the organism."

Keller asked her the question again. Tell me, "how do you do great science?" As Parker Palmer describes the conversation, McClintock again paused and thought about the ears of corn she had loved and worked with all her life. And she said, "Really, all I can tell you about doing great science is that somehow you have to learn to lean into the kernel and listen. You have to love the corn."

Barbara McClintock understood that great science is not only about rigorous observation, but it's also about wonder, awe and love. Great science is a live encounter with what the poet Rilke called the "great grace of things."

A friend of mine, who is an accomplished equestrian, said when she was a child training her horse to jump hurdles her trainer told her—"the only way you'll ever get your horse to jump is to throw your heart over first." Our children need to know that this is also how great science is done; currently they have no idea that love and science are partners. "Love is the only emotion that expands intelligence" (Maturana & Bunnell, 1999). We must learn to love the subject and hold its "great things" at the center of our inquiry.

We'll turn in a moment to the design of the new map, but first I want to name another context that profoundly impacts our work and our design of generative learning environments, and it is the role of digital technology and the Internet in brain and mind-shaping. In many ways our students are navigating a cognitively bifurcated and even bipolar world—the siloed and compartmentalized modes of "school learning," and the connected and collaborative modes of engaged and networked "life" learning.

So, the paradox and the challenge for us is that our students already come to us with "minds" "decidedly different" from our own. They: seamlessly interact and navigate with multiple forms of digital technologies, almost as if they and their tools are of "one mind"; are in constant intense and simultaneous communication with their peers through texting and multiple social networks; are fluent in video gaming, simulations, 3D modeling, and multi-user virtual environments; are globally connected and not bound by place, time, culture, or age; create adaptive and more fluid identities that enable them to be "at home" in multiple geographies and cultures; and they are on Facebook, MySpace, Twitter, YouTube, and Second Life, and often their Second Life avatars can fly.

Former Microsoft executive Linda Stone calls this "continuous partial attention" (Conley, 55). And it can come at a significant cognitive and emotional cost—rewarding speed, immediate utility, short gains, and the illusion of learning at the expense of deep understanding. According to Nicholas Carr, former executive editor of the *Harvard Business Review*, "our use of the Internet involves many paradoxes, but the one that promises to have the greatest long-term influence over how we think is this one: The Net seizes



our attention only to scatter it. We focus intensively on the medium itself...but we're distracted by the medium's rapid-fire delivery of competing messages and stimuli. Whenever and wherever we log on, the Net presents us with an incredibly seductive blur...it is very different from the kind of temporary, purposeful diversion of our mind that refreshes our thinking...The Net's cacophony of stimuli short circuits both conscious and unconscious thought, preventing our minds from thinking either deeply or creatively" (10).

What Our Children Have Lost—Cognitive and Emotional Costs

Our children will not be able to solve the deep systemic problems that cast an ominous shadow over the global community, and our own societies until we reconnect them to the roots of what it means to be fully human and to what they seem to have lost: a sense of personal identity, meaning and purpose; a sustained commitment to deep and often "slower" learning (sign in the hotel elevator: "I am a slow lift. Please enjoy a tranquil ride"); the compassionate use of knowledge and a global concern for human and community prosperity, and moral action in the world; the capacity for silence, solitude and reflection; the intimate connection and collaboration of youth and elders around shared purpose; sense of wholeness, connectedness, relatedness and belonging to the natural world and to one another; a deep awareness that they are part of something bigger, more mysterious, wondrous (existential intelligence, Howard Gardner), and a commitment to ecological sustainability and the embrace of nature as a sacred and healing dimension of our lives.

As Buddhist monk Thich Nhat Hahn said: "If you want the tree to grow, it doesn't help to water the leaves, you must water the roots." The Internet may be watering the leaves of learning.

Greg Albrecht, a philosopher and professor of sustainability at Murdoch University in Perth, Australia, coined the word "solastalgia," which he defined as "the pain experienced when there is a recognition that the place where one resides and that one loves is under immediate assault" (Smith, 38).

He believes this sense of loss of one's place is not limited to indigenous or native populations that have been displaced or to those living near man-made environmental assaults, like oil spills or quarries—but to all of us, as the environmental degradation of our earth home escalates. What's so important for us as we re-imagine the 21st Century scientific mind and design learning for sustainable futures, are the questions Albrecht holds and I believe we share, about the link between mind and nature. They are premised on the belief that where we live informs who we become. Here are some of his questions: (1) How deeply are our minds affected by our displacement from nature? (2) Is there a direct line between the health of the natural world and the health of the mind? (3) What are the cognitive costs to ecological decline? (4) Are they manifestations of the "brokenness of the mind-nature relationship? (Smith, 39)

These questions relate to what is called "ecological unconscious" and are being studied in the emerging field of ecopsychology, whose premise is that "an imperiled environment creates an imperiled mind" (Smith, 40). Three arenas of research are prominent: How does nature optimize the mind? (Smith, 40); Will our nature-reduced lives be impoverished from the standpoint of human functioning and flourishing?; As we move further away from nature and the fundamental forces that shaped our minds, how do we reconnect to them? (Smith, 41) I love these questions because they are so fundamental to understanding who we are and how we belong to the natural world to which we are so inextricably connected.

Does it not make sense that the principles that govern the emergence and sustainability of life—its interdependence, creativity and self-organization, would also govern the healthy and whole development of mind and the shape of our cognitive maps? Does it make sense that an intentional separation, by design, of mind development and learning from these fundamental principles and conditions might lead to cognitive impoverishment, disorientation and dis-ease?

For me, the answers are "yes," and so it means we have a design problem—to design for ecological awareness/consciousness and a sense of interconnectedness with nature and one another—Ubuntu ("I am



because you are; we are all connected”). Our students’ minds are being cognitively wired in ways ours simply have not been. It has neurological consequences—not only because of what they are doing online—but also because of what they are not doing off-line and it has global consequences, because mind-shaping is world-shaping.

Pioneering neuroscientist Michael Merzenich noted, “when culture drives changes in the ways we engage our brains, it creates DIFFERENT brains” (Carr, 10). To be fair, our children’s digital fluency, growing convergence between learning, work, play and social relationships, comfort in 24/7 collaborative multigenerational learning environments and interactivity, bring enhanced capacities and tools to learning (enhanced processing of visual cues and pattern recognition) and comfort in multi-generational learning environments.

Yet, through design, we must ensure that their need for instant gratification; impatience for more and more information and stimulation; distractedness, divided attention and “speed of light” multitasking; often cursory information surfing and scanning; superficial engagement in knowledge and meaning construction; and almost immediate skepticism toward and rejection of traditional modes of learning do not lead to shallow inquiry and understanding; erroneous data and evidence assessment; simplistic and ethically agnostic problem solving; and disengagement with nature and the physical world. Technology is not a substitute for authentic experience and real life.

What’s so important for us is that this cognitive orientation is antithetical to developing the habits of mind essential for engaging in “real” science. The Net is here to stay, but according to Jordan Grafman (head of the Cognitive Neuroscience Unit at the National Institute of Neurological Disorders and Stroke), “improving our ability to multitask actually hampers our ability to think deeply and creatively... The more you multitask, the less deliberate you become; the less able to think and reason out a problem. You become more likely to rely on conventional ideas and solutions rather than challenging them with original lines of thought” (Carr, 13). “What we’re doing,” University of Michigan neuroscientist David Meyer says, “when we multitask is “learning to be skillful at a superficial level” (Carr, 13).

As Seneca reminds us “to be everywhere is to be nowhere.” Here’s our fundamental challenge: the stimulation and nonstop input from the net, does not prepare learners to integrate its dazzling speed and ubiquitous 24/7 environment with the deeper, slower, longer, and more reflective learning required to develop and integrate “both/and” minds—scientific and social literacy, ecological integrity, economic vitality and social equity and justice.

This is our work—to ensure that the decontextualized and shortened time horizon of the Internet does not erode the values and habits of mind that make us fully human—and that enable us to do great science.

How do we do it—by design; by creating a new map (which we’re discussing during the workshop) that grounds their learning in personal meaning and purpose; immerses them in the complexities and challenges of messy consequential real world problems; engages them in the big ideas, and paradoxes of the human experience and the questions that really matter and beg for their contribution and response; ignites their passion and insatiable curiosity to make a difference; provides an experiential terrain of connections and integration that enables them to use all the ways they come to know; ensures they have time and space for reflection and replenishment; and uses technology as a integrating tool—expanding and engaging the global commons.

This new map helps bring the new story of learning to life by designing and creating generative learning environments in which integral and wise minds are nurtured—environments that are “naturally right, by design” (A. Lubow). This map is grounded in how our brains function and how we learn.

We know the brain’s structure is malleable and modifiable and can change through experience. We know that thinking and learning can change the its structure and function and alter its cortical map (Begley, 2007)—called self-directed neuro-plasticity. And we know that each time we learn a new skill or develop a



new ability, the brain is modified on a substantial scale, physically and functionally; it continually rewires and remaps itself, increasing its connections and the complexity of its neural networks. All of this helps us understand that the more ways we learn and teach—visually, auditorally, physically, tactically—the stronger the associations—the more regions of the brain are activated and the more cross-referencing connections are made.

Why is this so important? Because the nature and quality of our children’s learning experiences; the level of their attention, focus and engagement; the degree of their emotional intensity and resilience; the complexity and duration of their practice; and the frequency of their use and transference of multiple ways of knowing—all create the conditions for what they remember and for how long.

Neurons that fire together, wire together— and the more this happens, the greater our intellectual agility. But the reverse is also true, neurons that don’t fire together don’t wire together. Designing learning with the brain in mind, is not about what our children acquire, count, memorize and measure. It is about what they experience, construct, invent, imagine, dream, connect and live, and it is messy and unpredictable. Our brain simply does not function well in sanitized and prescribed, environments, and it resists the imposition of meaningless information.

We learn best and retain, and retrieve information more readily when we are engaged in exploration, novelty and surprise, when we are motivated and emotionally drawn to figure something out, and when we have slow time to reflect on what our learning means.

Learning occurs when new neural pathways are created or connected; our habits of mind and ways of thinking are shaped through immersion and repeated practice so what those experiences are matter profoundly. What we ask children to learn is important, but *how* we ask our children to learn is what shapes their minds and who they become. When children engage in deep inquiry, investigation, and experimentation, they learn to inquire, explore, and invent; when they creatively practice solving challenging, complex, and messy real-world problems, they learn to innovatively resolve complexity; and when they collaboratively wrestle with moral and ethical dilemmas, they learn to more imaginatively and wisely grapple with issues of social justice.

They learn to become more autonomous, improvisational, metacognitively aware and in control of their own minds and behavior. The locus of control for learning shifts from the teacher to them and they accept responsibility for shaping the nature and quality of their thinking and manifesting it in action. We get what we design for.

What we have designed for up until now, is neither the “epistemology” nor the “mode of education” that will ignite and nurture integral and wise minds able to imagine and set our desired future in motion by living it now. We need to design in harmony with how the brain learns. To do so requires that children are immersed in mind and practice fields that ensure learning is a live encounter because it is rooted in *purpose*, not prescription; *meaning*, not memory; *engagement*, not transmission; *inquiry*, not compliance; *exploration*, not acquisition; *personalization*, not uniformity; *interdependence*, not independence; *collaboration*, not competition; *challenge*, not threat; *questions*, not answers; and *joy*, not fear.

In this time of “wicked problems” (Kao, 24), integral and wise minds are the new “currency” for transformative and life-affirming global change. Yet for most children, including our most talented in STEM, the current school/science story, and the prescriptiveness, and formulaic nature of “school” math and science, mitigate against experiencing real science in a sustainability context.

They also mitigate against the experience of joy, wonder, and awe so integral to authentic scientific engagement and discovery. How we currently teach science has created a mental model antithetical with what science *really* is and who can and cannot do it. At a time when we need to develop science minded global citizens, there is an enormous disconnect between building new scientific minds for the future and



the current story (cultural narrative), map (design), and landscape (learning environment) of school science and mathematics.

Science is viewed as an exclusive enterprise—a club-only for those “born smart” enough to do it and it is seen as completely detached from the human experience. The rationale for developing STEM habits of mind is driven by the need for technological and economic superiority, not the advancement of the human condition. This utilitarian context completely dishonors who we are as learners. It ignores the joy of exploration and discovery, and the wonder and awe experienced when the mysteries of the natural world are discovered and illuminated, and it devalues the innate drive and desire of the human mind and spirit to understand how the world works and to contribute to a better world. It does not offer a compelling rationale to engage in science or devote one’s life to it.

To develop the transdisciplinary, creative and wise scientific minds our global community requires, we must tell our children the real science story and create conditions, *by design* that enable them to live it. We have walked away from the *long science story*, and decoupled it from our emotional connection to the human experience and the “grace of great things.” It is immersion in this “side of the story” that engages the energy and commitment of our youth to make a positive difference in the world.

Coming Full Circle

When I began, I said that my intent was to provoke and catalyze a conversation; to invite us to think differently about mind-shaping, by design; and to evoke our collective creativity in re-imagining and re-designing learning experiences and environments that liberate our children’s goodness and genius, and ignite and nurture the power of the human spirit for the world.

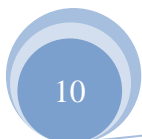
In a 2008 *New York Times* Op Ed piece titled “Put a Little Science in Your Life,” physicist Brian Greene (2008) wrote, “In reality, science is a language of hope and inspiration, providing discoveries that fire the imagination and instill a sense of connection to our lives and our world. Science is the greatest of all adventure stories, one that’s been unfolding for thousands of years as we have sought to understand ourselves and our surroundings. Science needs to be taught to the young and communicated to the mature in a manner that captures this drama. We must embark on a cultural shift that places science in its rightful place alongside music, art and literature as an indispensable part of what makes life worth living.”

So, how do we ignite and nurture decidedly different scientific minds that are both integral and wise? I hope it’s clear that we will more likely do so when we immerse them in learning landscapes where they can learn, play, create, invent, connect, and dream—by day. Goodness and genius are liberated through invitation. We will never mandate, prescribe, punish or test students into greatness. We shape the world from the inside out. The nature and quality of our thinking shapes who we become. And who we become shapes and changes the world.

The future prosperity and sustainability of our global community resides in igniting, nurturing, and connecting our children’s creativity and imagination to the needs of the world. Somewhere along the way our students missed the real and wondrous story of science; the dazzling story of our mind’s capacity to change our brain; and the exhilarating story of our imagination and passionate drive to use our collective genius, and goodness to change the world and ensure a constructive human presence on the earth.

We are the storytellers and mapmakers. And when we change the story, we change the map; when we change the map, we change the landscape. When we change the landscape, we change our experiences and our choices and when we do this—we can change our mind.

I return to the beginning and Hannah Arendt’s quote, “education is the point at which we decide whether we love the world enough to assume responsibility for it...and education, too, is where we decide whether we love our children enough not to expel them from our world... nor to strike from their hands their chance of undertaking something unforeseen by us, but to prepare them in advance for the task of renewing a common world” (Arendt, 196).



What our children need to know, do and become to “renew a common world” is reflected in notes I wrote to my five grandchildren several years ago. I have been told they are universal and so I close with them. For me, they actually serve as generative and life-affirming design principles for nurturing healthy and whole habits of minds and heart that can create a sustainable human presence on the earth.

1. *Slow down and learn something very well. Let go of right answers and illusions of objectivity, control, and predictability, and listen to your intuition and your heart.* Live from the inside out. Do not participate in your own diminishment, and always walk in the direction of your own learning and healing.
2. *Do everything with the seventh generation in mind.* The future is being born now in everything you do or do not do. Live a life of wholeness and connection. You are the seeds of a sustainable world. You are the mapmakers of our future.
3. *Honor and celebrate life in all its forms, be gentle with the earth, and absorb and embrace the wonder and beauty that surround you.* Beauty changes people. If you stop listening to nature, you will not be able to hear one another.
4. *Be a steward of your gifts, your passion, and your dreams.* The world desperately needs your imagination, your courage, your passion, and your commitment. Small stories have never stirred the soul. Dream big dreams, and create new realities worthy of your life. Be faithful to your own image of possibility, and remember that the price of passion and commitment is the shattering of personal illusions of safety. Be visible in the world so it can find you. You are grander than you can imagine.
5. *Say yes to belonging.* There is a songline woven into the universe, the earth, and life itself, and it is one of wholeness, coherence, connection, and relationships. There is no such thing as alone or lost in the web of life.
6. *Find your own voice, speak your own truth, and choose faith and hope over cynicism.* All are choices, and cynicism will never invite the potential for goodness and genius that lives within you.
7. *Pay attention, and listen for the sacred that lies hidden in the ordinary.* Your spirit and soul breathe best when you are still. So slow down, cherish silence, and listen for what wants to emerge. Percussive conversations do not welcome your inner voice. It is the depth of your attention that allows you to access the depth of your own identity.
8. *Decide what you want your name on.* Your name is everything. It is your identity and your integrity. Remember your name, and reclaim your life for the world. Put your signature on impossible causes; they are the ones most worthy of who you are.
9. *Invite yourself into a life of learning, and choose the questions you want to be holding for your life.* Your boundless capacity to learn and grow your mind is the path to transformation—yours and the world’s. New minds can shape new possibilities, and new possibilities can create new realities. You can indeed shape the future. Be mindful of what you learn and how you learn it. Seek connections and wisdom. Understand the meaning of “enough.” Embrace wonder, welcome surprise, and always, always keep learning.
10. *Remember that contrary to the voices, images, sounds, and messages that surround and bombard you, your life is about:* Your integrity, not your position; Your voice, not your power; Your name, not your title; Your calling, not your career; Your legacy, not your success.

So think and learn more slowly. Listen to your heartsong. Honor the voice of possibility that calls you. Notice what diminishes you and what makes you come alive. Embrace your questions, treasures, and gifts with gratitude. Passionately commit to impossible causes. Love generously, and pay attention to the deeper song that connects all of life, including your own. Believe in your own goodness and genius, and always, always keep learning. You can be the ones to imagine and create a just, compassionate, peace-filled and sustainable world for us all (Marshall, 2006).

Love, Grandma Steph



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