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Cover: In a two-and-a-half hour performance, artist Tony Orrico used his body as a drawing and measuring tool as he reinterpreted Hildreth Meière’s iconography of the history of science, which appears on the ceiling of the Great Hall of the National Academy of Sciences, Washington, D.C. (See page 38 and “TonyOrricoPerformance May2010” at www.youtube.com/user/CPNAS/videos.) Photo courtesy the National Academy of Sciences
A Lifetime of Curiosity: Science Centers and Older Adults

Wendy Pollock, editor

A Lifetime of Curiosity offers positive examples, inspirational stories, and resources for museums seeking to expand their engagement with older adult audiences.

Enjoy stories from older staff and volunteers making a real difference through their work in and with science museums, highlights of several science museum programs popular among older adults, as well as valuable and practical resources you can use, including a checklist and reminders about issues of comfort and accessibility.

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I begin this column with a confession of sorts. I am not a science fiction (SF) reader. And yet, I am intrigued by the recent commentary of renowned SF writer Neal Stephenson in *World Policy Journal*. (See also Robert Stein’s article beginning on page 22.) Stephenson laments the loss today of the “techno-optimism” of science fiction’s Golden Age—from Tom Swift’s photo telephone, to radio-transporters and robots in the works of Arthur C. Clarke and Isaac Asimov, to James Bond’s inventive gadgetry.

Where are those sources of imaginative innovation today? Where is the counterbalance to the apocalyptic tones of so many writers (and game designers) and the scientific skepticism and innovation risk aversion emerging in the general public?

Stephenson makes a call to his fellow SF writers for a more exciting, inspirational “Big Stuff Gets Done” approach to science literature. I see clear parallels in the work of our science centers and museums. Our ability to present the facts of science is not in question, and our desire to inspire generations of interest in science is understood. But are we featuring the risk-reward ratio of science as it applies to innovation or that unpredictable journey (complete with occasional dead-ends) from research to new exciting technologies?

ASTC is taking on this challenge with the formation of a new thought group specifically designed to promote more innovation-related themes in our science centers and museums—not just the advent of new gadgets, but the inspirational pathways that make this innovation possible. There is a change-maker in all of us, and society has come to count on this quality to meet our basic needs, enliven our lives, and confront our greatest global challenges.

Innovation starts with “tinkering,” and this is frequently well featured in many of our institutions. And yet, somehow, resistance to and trepidation about change can creep into our collective mindset. Let’s find ways to quell that notion and give our youth a future of “techno-optimism” not “techno-phobia.” To learn more about the new innovation thought group, contact Kate Crawford at kcrawford@astc.org.

Anthony (Bud) Rock (brock@astc.org) is ASTC’s CEO. Visit ASTC’s website (www.astc.org) to read more From the CEO editorials.
I started my career in informal science believing that Hispanic visitors were the new audience that science centers, including mine, should strive to connect with. Because of my experience as an ASTC Diversity and Leadership Development Fellow at the 2011 ASTC Annual Conference (covered in the January/February 2012 issue of Dimensions), my vision for diversity was transformed.

I returned from ASTC 2011 with an understanding that diversity in our field is about more than attracting visitors of a certain ethnic background. I realized more than ever that only museums with truly diverse staff will succeed in engaging audiences across ethnicity, race, gender, sexual orientation, and other categories.

It’s convenient (and perhaps less threatening) to imagine “diversity” in terms of quotas for skin color, ethnicity, etc. But true diversity lies in cultural filters and social perspectives—in other words, diversity can only exist when a variety of minds are present.

Practitioners need to consider the diversity of thought that our colleagues—no matter what their background—bring to the table. A staff with a diversity of perspectives will undoubtedly create content that reflects that diversity, and ultimately, attracts visitors that truly reflect our communities. More than ever, I believe that honoring diverse ways of thinking within the field should be the first and most vital step to creating more inclusive programming for all audiences.

*Hever Velázquez, research and evaluation associate
Oregon Museum of Science and Industry, Portland*

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**UNIQUELY FLORIDA**

With the opening of its 34,000-square-foot (3,160-square-meter) EcoDiscovery Center last November, the **Museum of Discovery and Science** in Fort Lauderdale, Florida, nearly doubled its exhibit space. Five new exhibit areas on two floors actively immerse visitors in Florida’s natural environments, past and present.

“The center brings to focus issues that are special to Florida while having worldwide environmental implications,” says Kim L. Cavendish, the museum’s president/CEO.

Visitors can watch four river otters frolic in a re-creation of a spring-fed Florida river. They can twist and turn in an airboat as a widescreen film produced by IMAX cinematographer James Neihouse helps provide a simulated ride through the Florida Everglades. Or they can step inside the mouth of a 50-foot (15-meter) prehistoric shark or dig up a fossil of the largest turtle that ever lived. Other exhibits demonstrate the importance of water in Florida or provide an opportunity to experience winds of 95 miles (150 kilometers) per hour.

“We get a lot of squeals coming from the walk-in hurricane,” says Cavendish.

Major donors included AutoNation ($3 million), JM Family Enterprises ($2 million), Broward Health ($2 million), Republic Services ($1 million), Bank of America ($1 million), and Carnival Corporation ($1 million), as well as a number of other organizations and individuals. —Sharon Barry

*Details: Kim L. Cavendish, president/CEO, kcavendish@mods.net, www.mods.org/exhibits/discovery.htm*

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Children experience a virtual airboat ride in the Florida Everglades. Photo courtesy the Museum of Discovery and Science
SPARKING DISCOVERY

A spark is a flash of inspiration. In the case of TELUS Spark, Canada’s first new purpose-built science center in nearly 30 years, it also stands for Science, Play, Art, Relevance, and Knowledge. TELUS Spark, located in Calgary, aims to ignite wonder and excitement about science, technology, and creativity among residents of southern Alberta, and to help visitors develop the confidence and skills to thrive in a global world.

“Our emphasis is on visitor-driven participation,” says Maureen Henderson, vice president of marketing and communications. “Visitors can repeat their experiences, and there will always be a different outcome.” For example, in Raindrop DJ in the Earth & Sky Gallery, visitors can collaborate with one another to create a piece of music using the sounds of dripping water. In the Energy & Innovation Gallery, visitors can use creative problem-solving to build a pipeline. Open Studio, created with teens in mind, features Paint with Music, which invites visitors to compose a musical symphony with color. The Creative Kids Museum features experiences for children up to age 8.

With more than 52,000 square feet (4,830 square meters) of exhibit space, the museum opened last October after more than a decade of planning and construction. The CAD 160 million project was funded by equal contributions of CAD 40 million from the federal, provincial, and municipal governments and the public sector. TELUS was the major corporate donor. —S.B.

Details: Maureen Henderson, vice president of marketing and communications, maureen.henderson@sparkscience.ca, www.sparkscience.ca
spotlights

FOLLOWING IN LEONARDO’S FOOTSTEPS

In a former library building in Salt Lake City, Utah, young people and adults can now produce their own animations or zoom in and out of a satellite map with their feet. These are a few of the interactive experiences available at the Leonardo, a new museum that combines elements from science, technology, and art to inspire creativity and innovation.

The 100,000-square-foot (9,290-square-meter) center opened on October 8 after a two-year renovation supported by a $10 million municipal bond. The Leonardo merged with the Utah Science Center in 2009.

Named after Renaissance artist, scientist, and inventor Leonardo da Vinci, the Leonardo promotes skills needed in the 21st-century world. “We ask questions and come at topics from different perspectives,” says Lisa Davis, director of marketing and communications. “We also create environments that encourage visitors to look at the world in new ways.”

For example, Dynamic Performance of Nature by Brian Brush and Yong Ju Lee is a 92-foot (28-meter) media installation that uses nearly 2,000 LEDs to create a constantly changing, interactive image of the global environment—including temperature, wind speed and direction, and seismic events. Philip Beesley’s sculpture Hylozoic Veil, which rises three stories high and wraps around the escalator, changes in response to visitors’ presence.

“When it all comes together, you get something that’s bigger than its parts,” says Davis. —S.B.

Details: Lisa Davis, director of marketing and communications, lisadavissslc@att.net, www.theleonardo.org

Top: In the Gene Lab, visitors can participate in a real scientific study that is exploring a possible link between genetics and the ability to “super task.” Photo courtesy the Leonardo

Bottom: Hylozoic Veil by Philip Beesley serves as both an aesthetic marvel and a laboratory for developing responsive architecture technologies. Photo courtesy the Leonardo
THINK ABOUT IT

“Like humans, animals think, use tools, and plan actions in order to survive,” says Martin Weiss, senior scientist at the New York Hall of Science (NYSCI), Queens. To deepen understanding of the evolutionary connections between human and animal cognition, and stimulate concern for animal welfare, Weiss collaborated with colleagues at Hunter College of the City University of New York; the Institute of Learning Innovation, Edgewater, Maryland; and designer Jeff Kennedy Associates, Somerville, Massachusetts, to develop Wild Minds: What Animals Really Think.

The 1,500-square-foot (140-square-meter) traveling exhibition, funded by a $2,131,193 grant from the U.S. National Science Foundation, opened in October at NYSCI and the Staten Island Zoo. In February, it began touring four other U.S. museums: Oregon Museum of Science and Industry in Portland; California Science Center in Los Angeles; Science Central in Fort Wayne, Indiana; and COSI in Columbus, Ohio. At each stop, exhibit elements are also displayed at a partnering zoo.

Designed for families with children, exhibit components include videos, games, and displays related to communication, self-awareness, learning, emotion, problem-solving, and tool use. In one popular activity, visitors take a numbers and spatial memory test and compare their results with a chimpanzee’s. “I think visitors are humbled by it,” says Weiss.

The project included front-end and formative evaluation, as well as remedial evaluation before the national tour. A summative evaluation will determine whether the exhibition attained its goals and will assess the effectiveness of the museum-zoo partnerships. —S.B.

Details: Martin Weiss, senior scientist, mweiss@nyscience.org, www.nysci.org/learn/news/article/wildmindspressrelease

Visitors to Wild Minds learn about how lyrebirds mimic sounds in their environments. Photo courtesy the New York Hall of Science
Google Science Fair

The Google Science Fair is an online science competition seeking curious minds from across the globe. Anyone between the ages of 13 and 18 can enter; all they need is an idea. Prizes include scholarships from Google and experiences from competition partners (including LEGO), and the grand prize includes a National Geographic expedition. The competition closes April 1; visit www.google.com/events/sciencefair/index.html for details. (Competition information is available in 14 languages, including English.)

ASTC Communities of Practice

In recognition of the science center and museum field's rich history of collaboration, and ASTC's priority on supporting staff at member institutions, the association has created a new professional development initiative: ASTC Communities of Practice (CoPs).

Officially launched at the 2011 ASTC Annual Conference in Baltimore last October, CoPs are special interest groups, initiated and led by science center professionals who wish to interact regularly with peers to share their concerns, passions, and best practices. The ASTC professional development team is providing dedicated staff support to each CoP, as well as access to a number of online tools (including ASTC Connect (connect.astc.org), webinar hosting, and conference calls), free of charge.

Since the announcement in October, a number of existing peer networks have joined the CoP effort, including the Teacher Education Network (TEN), the Mid-Atlantic Youth ALIVE! Network (MAYA), and Network for Leaders of Interpreters, Facilitators, and Explainers (NET Life). Two new vibrant CoPs have also been established: the Advocates for Diversity CoP and Public Engagement with Science CoP.

Participation in CoPs is open to all staff at ASTC-member institutions. We are actively looking for ideas for new CoPs. For more information on joining and creating CoPs, visit www.astc.org/profdev/communities/index.htm.

Deals for Students

Student subscription rates for Dimensions magazine are now available (USD 35 in the United States, USD 45 elsewhere, or USD 29 electronic edition). Students also receive a free subscription to the biweekly INFORMER enewsletter. Visit www.astc.org/pubs/dimensions.htm to subscribe. Also, we offer students the member rate on all publications (www.astc.org/pubs). To receive the student rate for Dimensions and all other publications, you must provide a copy of a valid student ID.

Remember: Any paid staff member at an ASTC-member institution can request a free print or electronic subscription to Dimensions at members.astc.org. Spread the word to your colleagues. To purchase a gift subscription for a nonmember (USD 55 in the United States, USD 65 elsewhere, or USD 35 electronic edition), visit www.astc.org/pubs/dimensions.htm.
THANK YOU TO THE FEMSA FOUNDATION

ASTC wishes to express its extreme gratitude to the FEMSA Foundation in Mexico for its recent gift of $50,000 to support the association’s international youth programs. This generosity helps ASTC greatly increase the reach of programs geared to connect youth across the world with the power of science.

NEW GOVERNING MEMBERS APPROVED

ASTC’s Executive Committee recently approved the following three science centers as new Governing Members.

The Chabot Space & Science Center, Oakland, California, inspires and educates students of all ages about the earth and the universe. The center and its 51 full-time staff offer visitors a full program of hands-on exhibits, large screen shows in the planetarium, historic telescopes, and workshops focusing on earth and space sciences. Chabot serves over 165,000 visitors, 50,000 students, and 2,000 teachers a year.

CuriOdyssey (formerly Coyote Point Museum for Environmental Education) in San Mateo, California, comprises a science museum and native wildlife zoo. The center brings visitors up close with the natural world through interactive science exhibits, animal encounters, and environmental science programs. With 20 full-time staff and a $2.6 million budget, CuriOdyssey operates indoor and outdoor exhibits, including a 4,000-square-foot (370-square-meter) walk-through aviary.

The mission of Exploration Place, Sedgwick County Science & Discovery Center, Wichita, Kansas, is to inspire a deeper interest in science through creative and fun experiences for people of all ages. The science center achieves its mission through exhibitions, films, planetarium shows, and educational programs. With 26 full-time staff and a $3.8 million budget, the center operates a 100,000-square-foot (9,290-square-meter) facility with seven galleries.

Notes from ASTC
notes from astc

SCENARIOS PROJECT

The ASTC-led project SCEnaRioS (Science Centers Engagement and the Rio Summit) aims to “twin” science centers in different parts of the world to create a dialogue on the major topics of discussion during the Rio+20 Earth Summit (www.unccd2012.org/rio20). The project is supported by the UN Educational, Scientific, and Cultural Organization (UNESCO) and funded by the Oswaldo Cruz Foundation (FIOCRUZ) from Brazil, and will be featured at Rio+20 in June.

A total of 15 partners, working in six groups, have been chosen to participate in the project:

1. **Guangdong Science Center**, Guangzhou, China; **Science Centre Singapore**; and **Questacon, the National Science and Technology Centre**, Canberra, Australia (water and health)
2. **Maloka**, Bogota, Columbia, and **Miami Science Museum**, Florida (water and coastal management)
3. **Canada Science and Technology Museums Corporation**, Ottawa; **Chabot Space & Science Center**, Oakland, California, and **Experimentarium**, Copenhagen, Denmark (global energy consumption)
5. **MadaTech, Israel National Museum of Science**, Haifa, and **Sci-Port: Louisiana’s Science Center**, Shreveport (green energy/energy consumption)
6. **MIDE, Museo Interactivo de Economía**, Mexico City, Mexico; **Museo Tridentino di Scienze Naturali**, Trento, Italy; **Philippine Foundation for Science and Technology/Philippine Science Centrum**, Marikina City, Metro Manila (topic to be determined).

Projects are already underway. For example, on October 29, 2011, students from Miami and Bogota met in a virtual coral reef research site created by the Miami Science Museum team. Then they engaged in a bilingual discussion on the questions raised by climate change.

WELCOME TO ASTC

The following new members were approved by the ASTC Board in October 2011. Contact information is available in the About ASTC section of the ASTC website, www.astc.org.

SCIENCE CENTER AND MUSEUM MEMBERS

- **Lutz Children’s Museum**, Manchester, Connecticut. This museum was formed in 1953 by a vote of the local Parent-Teacher Association council, and now serves 50,000 visitors annually in its historic schoolhouse location. The museum also operates the Oak Grove Nature Center, a 52-acre (21-hectare) nature preserve.
- **KidsQuest Children’s Museum**, Bellevue, Washington. In 1997, a group of local residents reacted to a survey in Eastside Parents Magazine identifying a children’s museum as the “most needed facility or service” in the community, and formed a committee. The museum opened in 2005 and serves more than 160,000 visitors annually.

SUSTAINING MEMBERS

- **LifeForms**, Bowling Green, Ohio. This company has designed and created more than 1,500 animatronic figures, ranging from miniature humans to giant animals, over the past 20 years.
- **OmniCosm Studios**, Los Angeles. OmniCosm Studios is dedicated to the production of scientifically accurate astronomical and scientific visualizations for large format film, television, print, and multimedia.
- **Vergeront Museum Planning**, Minneapolis. Drawing on more than 25 years of experience, this consultancy provides strategic planning and education planning services to science centers and museums at every stage of development.
- **Verner Johnson, Inc.**, Boston. For more than 30 years, this returning member has helped its clients plan and design science centers and museums. Their work includes **Great Lakes Science Center**, Cleveland; **Liberty Science Center**, Jersey City, New Jersey; **Guangdong Science Center**, Guangzhou, China; and **Museum of Science**, Boston, among others.
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To receive Destinology and learn more about PGAV Destinations, our visitor research projects, and our planning and design work, visit www.pgavdestinations.com/insights.
Along with traditional measures of financial performance and customer satisfaction, a successful science center needs to **show how it achieves its mission of engaging the public** in science and technology. An innovative approach would be to convert evaluation studies into measures that account for the quality of the visitor learning experience, and to include these measures in the museum’s organizational scorecard.

**Chantal Barriault**, co-director of science communication and senior scientist, research and evaluation, Science North, Sudbury, Ontario, Canada

We have recently developed a logic model based on a [21st-century skills framework](http://www.imls.gov/pdf/21stCenturySkills.pdf), which we are now using to inform and evaluate all of our exhibits and programs. We can better assess how engaged visitors are with the content, so that we’re not just measuring our success by how many people we served, or whether they went away knowing a single fact. Instead, we try to find out if our visitors have increased critical thinking, decision-making, and problem-solving skills that they can take with them and apply to other situations.


A science center’s success should be measured by **its impact on people, on the community where it exists,** and on the economic status of its community. Its overall success should be anchored to its achievement in the development and/or promotion of science culture.

**Dexter Bautista**, science research specialist, National Academy of Science and Technology, Taguig, Metro Manila, Philippines

When I was with the Austin Children’s Museum, we looked at repeat visitorship as a measure of success. For many years, the museum measured each year by **total attendance and number of memberships.** These are the two big numbers most museums would strive to grow. To achieve this, we tried to create an environment, exhibits, and programs that made folks want to come back again and often.

**Erich Rose**, Erich Rose Design, Austin, Texas

In the end, the **measure of success has to be about learning**—broadly defined to encompass both cognitive and noncognitive outcomes, such as engagement, interest, attitudes, behaviors, and skills. We need researchers and evaluators to continue to improve the means to capture these often elusive impacts.

**David Ucko**, president, Museums + more, Washington, D.C.

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At-Bristol in the United Kingdom has announced that Phil Winfield, director of INTECH Science Centre & Planetarium in Winchester, will take on the role of chief executive in April. Goéry Delacôte, who has served as chief executive since 2005, will remain involved as the museum’s president. During Delacôte’s tenure, At-Bristol has developed internationally recognized exhibitions and supported the development of new science centers around the world.

Alexandra Hesse, former associate executive director at the Leonardo, Salt Lake City, Utah, has been promoted to the position of executive director. She succeeds Peter Giles, who has returned to retirement in California now that the museum has opened, but will remain on the museum’s board.

Gretchen Faust Jaspering is now executive director of the Gulf Coast Exploreum Science Center, Mobile, Alabama. Jaspering formerly served as president of the Giant Screen Cinema Association and vice president of sales and marketing at the Saint Louis Science Center, Missouri. She succeeds Caroline Etherton, who was acting director for two years.

On January 5, Kathryn Keane became vice president of National Geographic Exhibitions. As part of this newly created role, Keane manages the National Geographic Museum, Washington, D.C. Keane joined the National Geographic Society in 2006 as director of the traveling exhibitions program. In December 2011, Susan Norton retired as director of the National Geographic Museum after more than 20 years of service.

Preeti Gupta has been named director for youth learning and research at the American Museum of Natural History (AMNH), New York City. In this role, Gupta is responsible for strategic planning and program development for out-of-school-time youth initiatives. Before joining AMNH, she was senior vice president for education and family programs at the New York Hall of Science, Queens.

ECHO Lake Aquarium and Science Center, Burlington, Vermont, has hired Brian Potvin as director of animal care and facilities management and Bill Elliston as public education manager. Potvin has worked at Houston Zoological Gardens, the Texas State Aquarium in Corpus Christi, and the Children’s Aquarium at Fair Park in Dallas. Elliston has worked at the Wildlife Conservation Society, the Brooklyn Children’s Museum, and AMNH.

The South Florida Museum, Bradenton, has chosen Ashley Burke as curator of collections. Burke has previously held positions at the Smithsonian National Museum of Natural History (NMNH) and the National Museum of Health and Medicine, both in Washington, D.C., and most recently at the John and Mable Ringling Museum of Art in Sarasota, Florida.

Elspeth Kursch is now exhibits manager at the Delaware Museum of Natural History, Wilmington. Before joining the museum, she worked in temporary exhibit production and digital imaging at NMNH.

After 16 years at ASTC, Donna McMillan retired from her position as director of administration on November 30. During her time at ASTC, McMillan worked with numerous board and committee members, volunteers, and staff. We thank her for her many contributions and wish her well.

Cindy Kong, who served as ASTC’s director of meetings and conferences for nearly 11 years, marked her last day with the association on January 27. We thank her for her years of hard work on ASTC annual conferences across the country, and wish her the best of luck in all of her future endeavors.

In January, Kalie Sacco became program manager of the Center for Advancement of Informal Science Education (CAISE), housed at ASTC. Sacco’s most recent position was a dual role as membership manager of the Coalition for Science After School and research assistant for the Center for Research, Evaluation, and Assessment at the Lawrence Hall of Science, University of California, Berkeley.

On December 9, 2011, Elizabeth “Liesl” Chatman, director of teacher professional development at the Science Museum of Minnesota, St. Paul, was one of 12 leaders honored as White House Champions of Change for their efforts to recruit and retain girls and women in science, technology, engineering, and math (STEM) fields.
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Collaborating on the Integration of Science and Art

By Helena Carmena Young

Science, Literacy, and Arts iNtegration in the Twenty-first Century (SLANT) is a year-long professional development institute for K-12 teachers in San Francisco.

Three years ago, the San Francisco Unified School District (SFUSD) launched a new professional development initiative to integrate science, literacy, and art in the curriculum while promoting 21st-century skills. The California Academy of Sciences and the de Young Museum, both in San Francisco, stepped up as community partners to design and implement this teacher institute with the school district. Through SLANT, teachers participate in integrated projects and collaborate to create their own activities that cut across concepts and practices in science, art, and literacy.

Through refining our educational vision and professional development design, we have learned several valuable lessons:

1. **Don't be afraid to try something new.** Teachers and students are eager for creative approaches to science. By integrating science, art, and literacy, teachers can make learning relevant and student-centered. It is important to support educators to take risks. Teachers participating in this program took on the role of researchers to assess the impact of this instructional approach on students.

2. **Help others see the big picture.** During the last 10 years, science and art have often been left off the agenda, with math and language arts taking precedence in U.S. schools. Science and art provide meaning, context, and personal connections to reading, writing, and math. We discussed the purpose and impact of integration with stakeholders through symposia, conference presentations, and large group reflections.

3. **Leverage the expertise and assets of your partners.** Select partners that bring knowledge, access, and resources that are beyond your reach. Then you can concentrate on what you do best as a science center, and rely on partners for assistance with new territory. In our case, SFUSD provided knowledge of classroom realities and real-world applications of lessons, while the deYoung Museum offered access to artists and artworks, as well as extensive knowledge of art.

4. **Document the process.** SLANT teaching and learning has been recorded and shared through digital photographs, video, wikis, websites, presentations, audio recordings, artwork, classroom data, and more. This information helps us spread excitement about the project and self-assess our teaching practices. It will also assist in creating future proposals for funding.

5. **Connect to national priorities in education.** Nations around the world are in need of a skilled 21st-century workforce. Integrating science, literacy, and the arts helps cultivate skills necessary for career success, such as creativity, critical thinking, and communication. As science, technology, engineering, and math (STEM) education becomes a national priority in countries worldwide, there is room for art as well. So let's put some “STEAM” in our education engine!

Helena Carmena Young (hcarmena@calacademy.org) is senior manager of teacher education at the California Academy of Sciences, San Francisco.
Intersections Between Science and Art

In order to meet the challenges of the future, we must build a workforce that is skilled and knowledgeable in science, technology, engineering, and math. But a basic understanding of these subjects is not enough; we also need to cultivate creative thinking and innovation. Exploring the intersections between art and science can promote critical thinking, creativity, and imagination, while encouraging public engagement with science. In this issue, science and art museum professionals, artists, and other practitioners share examples of successful creative collaborations, as well as practical advice for navigating the crossroads between science and art.

At Children’s Museum of Pittsburgh, the math-based artwork more light by Dick Estelle uses 890 strands of pink and orange surveyor’s tape to define a geometric form. Photo by David Bauckham
In a small clearing, surrounded by a canopy of trees, hover two aluminum rings, looking for all the world like twin alien spacecraft about to land. In reality, the sculpture by artist-duo Type A (Adam Ames and Andrew Bordwin) exists as an installation on the campus of the Indianapolis Museum of Art (IMA). Each ring casts its shadow on the ground below. As the seasons progress, the shadows’ positions shift, aligning precisely as one shadow during the summer solstice.

Dubbed Team Building (Align), the sculpture and the resulting shadows work as a metaphor for collaboration between individuals and organizations, but also point to a connection between the disciplines of art and science. Growing up, our schools instill a classical distinction between the arts and sciences, and as adults, our professional training continues to reinforce those barriers. Yet as we seek a culture of innovation and creativity, those boundaries between art and science are becoming more and more artificial, and perhaps even detrimental to a comprehensive view of the world that allows for out-of-the-box solutions to this generation’s most pressing issues.
In that light, it’s surprising that deep collaboration between art and science museums is a rare commodity. History demonstrates that the interchange of inspiration and ideas between art and science has always been fertile soil for innovation. Technology often mediates a symbiotic relationship whereby discoveries in science enable the advances of technology that artists then employ to express intangible and sometimes expansive ideas. This creativity, in turn, can inspire new ways of seeing that contribute to the process of scientific discovery. But with an ever-increasing focus on economy and efficiency, we are losing the ability to break out of cognitive models that keep us from experiencing true innovation.

ENCOURAGING INNOVATION

In a recent essay for World Policy Journal (www.worldpolicy.org/journal/fall2011/innovation-starvation), noted science fiction author and inspirational thinker Neal Stephenson laments the decline of the U.S. space program, and the seeming lack of inspiration available to accomplish “big ideas.” He observes, “The imperative to develop new technologies and implement them on a heroic scale no longer seems like the childish preoccupation of a few nerds with slide rules. It’s the only way for the human race to escape from its current predicaments. Too bad we’ve forgotten how to do it.”

Stephenson goes on to assert that science fiction writers are at least partially to blame for not providing inspirational “big visions” for scientists to grab onto, but rather focusing on the deleterious effects of technology on society. More importantly, he suggests that an aversion to risk and the fear of the unknown is the true innovation killer of our age. If society is looking for new sources of innovation, this relentless march toward efficiency seems a poor place to look. As John Maeda, president of the Rhode Island School of Design, observes, “Our economy is built upon convergent thinkers, people that execute things, get them done. But artists and designers are divergent thinkers: They expand the horizon of possibilities. Superior innovation comes from bringing divergents (the artists and designers) and convergents (science and engineering) together” (www.guardian.co.uk/technology/2010/nov/14/my-bright-idea-john-maeda).

HIGHLIGHTING CONNECTIONS

Luckily for art museums and science centers, the opportunities to highlight connections between the arts and sciences are numerous. For example, artist Mary Miss’s recent public art project FLOW: Can You See the River? (www.imamuseum.org/100acres/artists/marymiss) examines how people’s daily activities are connected to Indianapolis’s White River. The IMA worked together with the Butler University Center for Urban Ecology to explore how runoff from rainfall in Indianapolis impacts the river’s health. In connection with the art exhibition, visitors can use mobile technology (supported by a U.S. National Oceanic and Atmospheric Administration grant) to track the path of a raindrop from their current position as it flows toward the river (trackaraindrop.org).

For some practical ways to make the connection between art and science, why not consider a few of the following ideas?

- **Collaborate with a local art museum** and try to identify works in their collection that might illustrate concepts from your exhibits. Objects representing natural phenomena, or those that incorporate special materials like fiber optics, metal alloys, or light, are good possibilities.
- **Explore industrial design and talk to designers** about how they bridge technical requirements and scientific concepts while making something beautiful. The iPhone is a great example.
- **Interview artists** who communicate about “big ideas” with their art. Many times they are thinking about problems that scientists are addressing as well, such as energy consumption, recycling, technology, and human perception.

Connections like these are possible in every science center and art museum throughout the country. As centers of free-choice learning, art museums and science centers can easily benefit from highlighting these points of intersection and possibly inspire future innovation in the process.

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**Robert Stein** (rstein@imamuseum.org) is deputy director for research, technology, and engagement at the Indianapolis Museum of Art.

FLOW: Can You See the River? by Mary Miss appears along a 6-mile (10-kilometer) stretch of the White River in Indianapolis. Mirror markers and oversized red map pins identify key features of the watershed. (Mary Miss, FLOW: Can You See the River? © 2011, produced with EcoArts Connections + Partners, Commissioned by the Indianapolis Museum of Art. Courtesy of the Indianapolis Museum of Art, 100 Acres: The Virginia B. Fairbanks Art & Nature Park.)
The Common Ground of Art and Science Explorations

By Bernie Zubrowski

There has been a long-standing interest among some science educators and exhibit designers in making connections between the domains of art and science. In my own work with curriculum development, exhibit design, children’s science books, and especially the design of kinetic sculptures, I have had a similar deep interest.

Making this connection is rather challenging, and great care must be taken to present both domains with respect and integrity. I believe that moving back and forth between the two domains can spur the imagination and provide creative insights. However, after the initial stages of exploration, art and science diverge in their practices and final products, such as a painting or sculpture in the case of art, and a theory or model in the case of science.

DESIGNING KINETIC SCULPTURES

When I design and assemble kinetic sculptures (zubrowskib-sculpture.com/index.htm), I don’t start with a science concept and attempt to find some concrete embodiment that illustrates it. Rather, I start with an appealing movement or other aesthetic quality found in a natural phenomenon or technological artifact. Sometimes, certain materials evoke a response that, after some explorations, results in a sculpture.

One example of this approach is my explorations of air and water movement. I find movement such as waves on a body of water or leaves blown by the wind highly engaging. One day, while exploring a reef at low tide, I saw a sea butterfly moving in a wave-like motion. It gave me the idea for a sculpture that I created a number of years ago while I was artist-in-residence at the Exploratorium in San Francisco. The sculpture was a piece of sheer cloth suspended in a large tank of water. The cloth...
waved as a result of bubbles creating a current in the water. I didn’t attempt to relate the waving cloth to any specific science concept. I wanted to focus on the aesthetics of the movement.

COMMON GROUND

Over years of exploring, I have found many phenomena and technological artifacts with universal appeal: soap bubbles, wave motion in soap film and water, liquids moving within liquids, shadows, dyes and pigments, crystals, and others. Human-made objects such as mirrors, toy spinning tops, and some kinds of water-powered and mechanical clocks also have a certain aesthetic appeal. Some contemporary artists have designed artworks based on such natural phenomena and human-made objects. Exhibits in science centers and children’s museums also exploit these phenomena and objects, because they are appealing to look at and can be used as a hook to present scientific concepts.

After thinking about the appeal of these phenomena and inquiring into the literature on scientific discovery and scientific representation (e.g., diagrams and physical models), it occurred to me that a common ground for artists and scientists is the intrinsic aesthetic appeal of phenomena. For instance, a common aesthetic property is symmetry, such as the bilateral symmetry of mirrors and the rotational symmetry of spinning tops. By intrinsic I mean that people react to a phenomenon in a direct, unmediated way; their reaction doesn’t come from a cultural or social context. Semir Zeki, professor of neuroesthetics at University College London, suggests that our experience of art relates strongly to how the brain works. In a way, we are programmed neurologically to pay particular attention to certain movements and visual arrangements.

PROGRESSION, NOT INTEGRATION

Aesthetic appeal is more than a hook for engaging students or museum visitors. It can be the starting point for building conceptual models of phenomena and artifacts. In other words, there can be a developmental progression from direct sensory experience to abstract visual representations, such as electrical circuit diagrams or the energy levels of molecules.

To my way of thinking, this pedagogical approach does not integrate art and science. I believe that using the aesthetics of a phenomenon or artifact for artistic expression is a different pathway from using the aesthetics to stimulate scientific inquiry.

For example, I have also played around with dropping food color in a tray of water and highly diluted white paint. The spiral patterns and curvilinear lines created are very appealing. I introduced these materials to middle school teachers and students to use as a concrete context for developing scientific representations and exploring concepts in the field of fluid dynamics.

In the curriculum guide for implementing these activities, I did not suggest art activities, because the goals differed. The goal of the food color activity was to have a strong emotional impact, while the curriculum had the very different goal of engaging students and moving them toward understanding the scientific description of a natural phenomenon. I did not attempt to integrate art and science but rather exploited the high aesthetic appeal of fluid motion for the purpose of capturing students’ interest.

Some science exhibits and informal education programs already use appealing aesthetics as a launch to the pathway of delivering or teaching scientific concepts. A number of exhibits use mirrors, for instance. However, I’ve observed that some designers don’t trust the intrinsic appeal of aesthetically interesting phenomena and tend to embed them in all kinds of “bells and whistles,” such as sounds, lights, or other stimuli. Perhaps they feel these additions are needed to engage the attention of visitors or students. Of course, how phenomena are presented does make a difference. It takes a lot of work to arrive at designs that are simple, allow direct engagement, and provide a satisfying experience.

To reiterate, while initial explorations of a phenomenon or artifact can be common ground for artistic expression and scientific inquiry, there needs to be an explicit point at which students or museum visitors understand that the explorations are moving either to scientific experimentation or to the development of an art object. The processes for achieving these final products differ and need a different structure and guidance.

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Science Gallery: Creative Collisions of Art and Science

By Michael John Gorman

The explosive cocktail of art and science has been with us for millennia. We have long had individual practitioners—from Pythagoras to Steve Jobs—who defied disciplinary boundaries, but I personally think there is something very exciting going on now that makes art-science in the 21st century different. What seems to be emerging is a new generation of physical environments dedicated to nurturing “intersectionism.”

Since 2007, a number of these environments have opened around the world—including Le Laboratoire, Paris; the Art|Sci Center, Los Angeles; and Arts Santa Mònica, Barcelona. While these spaces each have their own distinct emphases, they are all examples of an emerging kind of cultural space, where science interacts with the arts and design in a conversational environment. There are, of course, earlier examples of spaces that have celebrated the intersection between art and science, including the Exploratorium, San Francisco, but the proliferation of hybrid spaces and approaches to bridging art and science in the past five years is remarkable.

So why is this emergence happening right now? I think the key reason is the crisis in specialization in our educational and cultural institutions catalyzed by the technological revolution since the 1990s. Whereas previous science centers were founded on the concept that we require more scientists, the new art-science centers and projects tend to spring from the idea of nurturing a new kind of person—an art-scientist—able to move across disciplinary boundaries with agility. The mission of these spaces seems to be about stimulating creative collisions rather than “instructing” the public about particular areas of science.

Science Gallery

Let me try to make this a bit more concrete by sharing some stories about the space we have established at Trinity College Dublin, Ireland. Science Gallery (www.sciencegallery.com), which opened in February 2008, began with a group of Trinity College Dublin scientists who wanted to create a center for excellence in nanotechnology. They thought that the building should also include a new way of engaging the public with emerging science and technology.

We looked hard at how we might do this. The space was quite small, so the possibility of creating an Exploratorium-style science center was out of the question. On the upside, we had a fantastic city center location, with a giant shop window onto one of Dublin’s busiest streets. We decided we had a unique opportunity to make the membrane between a major research university and the city more porous.

Science Gallery would not be a place to receive instruction about science dressed up as “fun,” but a “particle accelerator for people” from different backgrounds and perspectives to bounce off each other in creative collisions. Emboldened by the experiments beginning elsewhere in the world, we saw the dialogue between art and science as shorthand for a broader cultural exchange between the world of
During LIGHTWAVE in 2008, Science Gallery brought Eric Staller’s LIGHTMOBILE (a vintage Volkswagen Beetle covered with 1,659 computerized lamps and BUBBLEHEADS (a bicycle built for four riders, with each rider’s head appearing to be a bubble of light) to the streets of Dublin city center. Photo by Patrick Bolger

Some university scientists were highly skeptical about the concept of “a place where ideas meet.” We were very fortunate to have the support of an enlightened university president who insisted that bringing science and the arts into dialogue was critical, and allowed us to experiment with new models for public engagement.

We developed a very open, collaborative approach to interdisciplinary conversation. We select an extremely broad theme (like “light” or “fear”) and issue an open call for project ideas from scientists, designers, artists, and engineers in the community. An interdisciplinary group of curators reviews the proposals and invites a selection of applicants to develop their projects for implementation in the gallery. The advantage of the open call process is that it attracts a very wide (and unpredictable) range of project ideas, and proposers of projects are usually very enthusiastic, frequently giving their time to events in addition to their specific installation or exhibit.

INFECTIOUS IDEAS

Our INFECTIOUS project is a good example of what Science Gallery is all about. We were approached by two leading Trinity College immunologists with the idea of doing a show on the theme of Plague. We said, “Hmm, interesting idea, but sounds a bit...negative.” After brainstorming for a while, we thought: What about calling it INFECTIOUS, and considering everything from viral marketing to contagious laughter, as well as pandemics? We ended up opening the show—which contained a simulation using RFID tags, where visitors could “infect” each other electronically—in April 2009, just days before news of the H1N1 flu broke! Some people even blamed us in the media for starting the pandemic as a public relations stunt.

We had artists, immunologists, epidemiologists, designers, musicians, economists, and even comedians all engaging with contagion, the spread of ideas, jokes, financial panics, and fashion trends. The lead scientist in the project eventually published a three-page interview with an artist in Nature Immunology, a completely unprecedented move on the part of the journal.
SUCCESSES AND CHALLENGES
So what have we learned? Well, over the past few years we have identified some practices that seem to work:
• Establishing broad interdisciplinary themes that naturally bring scientists and artists into conversation
• Using open calls to source ideas from the community
• Shifting from being a content provider to being a creative platform
• Having artists and scientists in the gallery, willing to talk to visitors.

We have also identified some key challenges:
• Balancing a strong brand with an ethos of openness
• Addressing the concerns of some scientists who think the blend of art and science is too “fluffy” and would prefer to see more “hard science” presented in a didactic fashion
• Accepting the fact that traditional, tightly controlled exhibition narratives are impossible in this model
• Managing the workload created by rapid turnover of events and exhibitions
• Having sufficient resources for face-to-face interactions and conversations.

LOOKING AHEAD
Science Gallery’s next goal is to stimulate and support the development of a global network of galleries drawing from the lessons of the Dublin model, in partnership with leading universities in urban centers. The network will enable the sharing of ideas, experiments, and touring exhibitions, drawing on the unique artistic and scientific communities present in each city. In December 2011, Science Gallery was awarded €1 million (USD 1.3 million) by Google to support the development of the Global Science Gallery Network, which will be launched in July when Dublin is a City of Science and host of the Euroscience Open Forum (ESOF) conference.

Ultimately, a key challenge for the new generation of hybrid spaces, including Science Gallery, is how they can move from being boutique experimental spaces to “infecting” mainstream formal education with new approaches. Science Gallery is currently developing a Learning Lab to support formal education in Ireland in integrating art and science.

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In 1996, the Wellcome Trust—the United Kingdom’s largest charity, which supports biomedical and medical humanities research and public engagement with science—launched the Sciart funding program in response to the growing practice of science and art collaboration. Its original aim was to fund collaborations between artists and scientists to research, develop, and produce visual artwork that explored contemporary biological and medical science.
Sciart is widely considered to have been integral in supporting the development of a unique community of practitioners and a new form of interdisciplinary practice.

Over 10 years, Sciart supported 124 projects across all art forms, funding £3 million (USD 4.7 million) worth of awards. It is widely considered to have been integral in supporting the development of a unique community of practitioners, a new form of interdisciplinary practice, a body of science-related artistic work, and public engagement with science. Building on the program's success, the Trust launched the Arts Awards (www.wellcome.ac.uk/arts), a national program to fund arts inspired by biomedical science, in 2007.

**ARTS AWARDS**

The Arts Awards aim to stimulate interest, excitement, and debate about biomedical science; examine the social, cultural, and ethical impact of biomedical science; and encourage new ways of thinking and learning about science, all through the arts. The program covers all art forms and encourages projects that engage a range of audiences. Since 2007, we have made over 200 awards with a value of £5.8 million (USD 9 million).

The original vision of the Arts Awards was to encourage new practitioners to embark on medicine-related projects and to broaden the scope of this kind of artistic practice. Certainly, we have seen a vast shift in the types of organizations, artists, and projects that have been funded by the Trust since the program launch. We have funded opera; film; parkour (free running), interactive digital work; painting; and immersive theater, to name just a few examples. Grannholders range from individual artists to national arts organizations. Work is performed and shown to a range of audiences in science centers, museums, schools, theaters, community centers, and elsewhere.

**EXAMPLES OF SCIENCE CENTER–BASED PROJECTS**

A number of ASTC members have been involved in Arts Awards-funded projects:
- Theatre Sans Frontieres (www.tsf.org.uk) worked with the International Centre for Life (www.life.org.uk) in Newcastle upon Tyne, England, to create a two-week series of day-long workshops that incorporated drama, science experiments, French, and history, and took the discovery of radium by Marie Curie as a starting point for ethical debate.

![Disclosure Case, part of artist Revital Cohen’s Genetic Heirloom project series, explores the ethical question of whether parents should tell their children about genetic diseases they may inherit. Here, a woman chooses to open this ‘Pandora’s box’ and hears a message from her parents explaining the family's genetic heritage. Photo by Gary Hamill](image-url)
• The Science Museum (www.sciencemuseum.org.uk), London, commissioned artist Revital Cohen to produce *Genetic Heirloom* (www.revitalcohen.com/project/genetic-heirloom), which explores how our knowledge of our genetics influences our familial relationships and perceptions of ourselves.

• The Glasgow Science Centre (www.gsc.org.uk), Scotland, exhibited paintings from Franziska Schenk’s *In the Eye of the Beholder* project (franziskaschenk.co.uk), inspired by Darwin’s iconic description of the development of the eye. The artist worked with scientific advisors at the University of Birmingham to investigate the evolution of iridescence, color, display, camouflage, and perception in nature and in art.

There was an early preconception in the United Kingdom that arts and science interdisciplinary practice was predominantly concerned with the visualization of scientific principles. In fact, the vast majority of the work we see explores the wider social, cultural, ethical, and political issues behind the science and allows audiences to discuss what science means to them as individuals and part of society. The future focus of the Arts Awards is not about encouraging “Sciart” as an artistic form or supporting projects that offer scientific answers and didactic education, but rather on high-quality artistic practice that stimulates debate and raises questions about how science affects our daily lives.

**RECOMMENDATIONS WHEN CONSIDERING AN ARTS AND SCIENCE PROJECT**

Having read over 1,200 applications and overseen more than 200 Arts Awards projects in the last five years, I have seen a number of issues repeatedly arise. When thinking about a new project, you may want to consider the following points:

• **Think carefully about your subject area.** How will you make it relevant for your target audiences? How can you take a new approach to the topic that hasn’t been done before? Investigate other similar projects; the Wellcome Trust website (www.wellcome.ac.uk) is a good starting point.

• **Don’t have preconceptions about how the collaboration will work.** There is not a “one-model-fits-all” recommendation. It depends on the nature of the individuals and organizations involved.

• **Write down clear goals and expectations between collaborators up front to avoid disputes later.** This should include, at minimum, roles and responsibilities in the project, meeting schedules, intellectual copyright issues, and how the work will be credited.

• **Allow all collaborators to play a role in preparing any funding applications.** This will ensure that both the arts and science voices come across.

• **Consider a third party in a producing or curatorial role.** This person can help steer the collaboration and dissemination of the work.

• **Take a new approach to your marketing and outreach strategies.** Audiences for these types of projects are as broad as they come. Allocate sufficient budget and consider partnering with local arts organizations and academic institutions to broaden your dissemination.

• **Use both formative and summative evaluation.** The process of collaboration is as important as the artistic outcome, and it will be essential to document and share this journey. For larger projects, employ an independent evaluator.

—M.C.

**Meroë Candy** (arts@wellcome.ac.uk) is senior arts advisor at the U.K. Wellcome Trust. Evaluation of the Wellcome Trust’s Sciart program is available at www.wellcome.ac.uk/About-us/Publications/Reports/Public-engagement/Sciart-evaluation-report/index.htm.
An Art and Science Gallery

ReGeneration will be a new art/science exhibition at the New York Hall of Science, open from October 2012 through January 2013. The exhibition will explore the themes of community and sustainability through the newly commissioned work of 15 international artists. Many of the works will be co-created with community members. For example, Biomodd by Belgian artist Angelo Vermeulen is an art project in which community members build computer systems with living ecosystems inside of them. Eric Siegel, director and chief content officer, New York Hall of Science, Queens

Can you engage audiences with a science show with no words? Yes, if you are the Visualise team from science made simple. Visualise is a spectacle involving physical theater, live science demonstrations, projected images, clowning, and music. Using ordinary objects in extraordinary ways, the performance invites the audience to make their own observations and discoveries. Developed and performed by former staff from Techniquest in Cardiff, Wales, Visualise has been performed in 15 countries, including in many science centers and museums. Gareth Smith, science made simple ltd., School of Physics and Astronomy, Cardiff University, Wales, United Kingdom

The Anatomy in the Gallery program at the International Museum of Surgical Science has showcased rotating exhibitions of medically inspired contemporary art since 1998. Quarterly pairs of exhibitions feature artwork in traditional and new media that focuses on issues of embodiment, perspectives on medical practice, and the visual culture of medicine. The museum’s historical artifacts and educational exhibits provide a rich context for the art exhibitions, while the artwork adds another layer of experience for visitors, encouraging reflection on the nature of medicine and the human condition. Lindsey Thieman, manager of exhibits and programs, International Museum of Surgical Science, Chicago

For a wide variety of reasons, getting to a museum is not easy for everyone in Monterrey, Mexico. Planetario Alfa offers children the museum experience in their own schools through Ciencia Móvil (Mobile Science), an educational program that recreates the museum’s activities and demonstrations. Children then participate in dynamic workshops in which they reinforce the information seen in the demonstrations while creating artistic projects related to physics, chemistry, and astronomy. The program promotes creativity, cooperation, and interaction among students, teachers, and museum facilitators. Blanca Puente, Education Department, Planetario Alfa, Monterrey, Mexico

Biomodd by Angelo Vermeulen. Photo by Angelo Vermeulen

Visualise. Photo by Kiran Ridley
An Art and Science Gallery (continued)

At the turn of the 19th century, physicist Ernst Chladni found that when he took a violin bow to a thin piece of metal covered in sand, the granules arranged themselves in beautiful, geometric patterns according to places of stillness and vibration. Last year, Exploratorium Artist-in-Residence (AIR) Meara O’Reilly discovered that with carefully sung notes and a transducer driving a similar plate, she was able to explore those same resonances. When she handed a microphone to museum visitors, she found that even untrained singers can make exquisite patterns in the sand. O’Reilly is currently working with our exhibit developers to transform her experiments into our next AIR exhibit.

Stacy Martin, public information assistant, Exploratorium, San Francisco

The Children’s Museum of New Hampshire has always offered a mix of art, science, culture, and history. Recently, we have focused on blending perspectives. This approach is captured in our new Science, Technology, Engineering, Arts, and Math (STEAM) Coordinator, and in the creation of two new maker spaces: The Studio, which focuses on creative thinking and open-ended exploration, and Thinkering Lab, which contains engineering challenges involving design. Being interdisciplinary makes it more possible for families to explore together, which research tells us is central to deepening informal learning outcomes.

Justine Roberts, executive director, Children’s Museum of New Hampshire, Dover

Last year, the Louisville Science Center experimented with a new hands-on festival combining art and science. The Great Big Science To-Do consisted of three month-long, internally designed exhibitions. October’s Colorama allowed visitors to paint with magnets, texture stamp, and paint Frisbees using centrifugal motion. At November’s Weatherblast, which explored how weather affects us, visitors created their own suncatchers using baby oil and construction paper. Reuseapalooza, held in December, promoted repurposing and recycling old objects as visitors made holiday ornaments and gift tags from recycled materials.

Mark Sieckman, manager of executive initiatives, Louisville Science Center, Kentucky

Visitors make holiday ornaments at Reuseapalooza. Photo courtesy the Louisville Science Center
As part of its opening, the Durango Discovery Museum instituted StudioLab, an “art + science” collaborative program. Every year, from May to August, an artist-scientist team works on a project at the museum. The selected artist-scientist team receives a $500 honorarium at the end of the project. In year one, artist Miki Harder worked with Jonathan Wolfe, executive director of the Fractal Foundation, on an inquiry into fractals. This past summer, photographer Paul Pennington and partners engaged the public in a variety of optics and camera obscura projects. Haz Said, director of marketing, communications, and visitor experience, Durango Discovery Museum, Durango, Colorado

Art2STEM—which approaches science, technology, engineering, and math (STEM) through the vehicle of art and design—is changing middle school girls’ minds about careers in the sciences. After experiencing the program, many girls who previously had no interest in STEM careers choose to enroll in Nashville’s STEM academies in ninth grade. Adventure Science Center works with local nonprofits, businesses, universities, volunteer mentors, and the public school system to deliver project-based science and engineering activities followed by field excursions to local businesses and a week-long summer camp. The program has served more than 400 girls to date. Jeri Hasselbring, director of education, Adventure Science Center, Nashville, Tennessee

House of Music is a modern interactive sound museum located in the historic city center. Six floors are dedicated to the presentation of the fascinating world of music and sound. Music becomes audible and visible in real and virtual rooms. Visitors engage in interactive play with music, learn about the history of music, experience unexpected sounds, and encounter music from aesthetic, scientific, popular, and artistic perspectives. Helmut Lenhardt, marketing and public relations, House of Music, Vienna, Austria

As we were designing ArtScience Museum, which opened in Singapore in February 2011, we decided to look at the creative process. In both art and science, an idea begins with a spark and evolves from there. We looked at the inspiration of art-scientists like Leonardo da Vinci and Lu Ban, and found that they typically went back to nature. For example, da Vinci’s drawings of flying machines were inspired by his observations of bat wings. The museum’s three galleries—Curiosity, Inspiration, and Expression—invite visitors to explore these connections between art and science.

Tom Zaller, president, Imagine Exhibitions, and founding director, ArtScience Museum, Singapore

To read more about projects bridging art and science, visit www.astc.org/blog/category/astc-dimensions.
One might ask, “What place does art have in a science center?” Yet, over the past several decades, many international artists, museums, and educational institutions have found that the terrain between disciplines is fertile ground for exploration. Efforts to reach across disciplinary boundaries can allow people to gain a different perspective.

The National Academy of Sciences (NAS) in Washington, D.C., has a permanent art collection and holds art exhibitions and other cultural events to explore relationships between culture and science. A goal of Cultural Programs of the National Academy of Sciences (CPNAS, www.cpnas.org) is to encourage visitors to make connections between ideas in a different and unexpected way through exhibits that reflect contemporary issues and the dialogue around interdisciplinary exchanges.

**ART IN THE NAS: CONTEXT AND MEANING**

Since the historic home of the NAS was constructed in 1924, artists have been included in the process of defining the physical space as well as developing a visual identity for the institution. The Academy’s mission, as chartered by the U.S. Congress in 1863, is to advise the nation and its leaders on issues in science and technology. This fact creates a unique context for the interpretation of the artwork on display. The art in the original building was intended to remind visitors of the vast constellation of ideas represented in the history of science. Many artists contributed, including Hildreth Meière, whose iconography of the history of science adorns the ceiling of the Great Hall.

In May 2010, performance artist Tony Orrico reinterpreted Meière’s iconography through his own investigative method. In the presence of staff and visitors, Orrico engaged in a two-and-a-half-hour performance. On a 20-square-foot
(2-square-meter) sheet of white paper, he used his body as a drawing and measuring tool to simplify Meière’s iconography to gestural drawings. With charcoal in both hands, he pivoted in a circle, like a life-sized Spirograph. (See cover photo and “TonyOrricoPerformance May20 2010” at www.youtube.com/user/CPNAS/videos).

The unusual and unexpected performance in a science space kept viewers mesmerized. The resulting work, based upon the disciplines of science, was much more than a performance. It was an aesthetic investigation beyond simple illustration. Such an artistic act in a non-art context asks the viewer to consider the connectivity of diverse ideas such as biomechanics and aesthetics, endurance and performance, and the creative outcomes that can be produced with the simplest of technologies. Such a divergence in a visitor’s expected experience opens the mind to new ways of thinking.

**T I M  R O L L I N S  +  K.O.S.**

The artist’s path is a unique arc of inquiry with its own structure, goals, and outcomes. The physical act of creating art, at its heart, is a learning and investigatory process. This is evident in the work of Tim Rollins, who, in the 1980s, gained recognition for his work with learning disabled students in the Bronx. Rollins taught literature to students who had been labeled “unteachable” by encouraging them to draw on the pages of books they read. The students, who eventually named themselves Kids of Survival (K.O.S.), found personal meaning in the literature through this kinetic process of art making. The idea behind Rollins’s method was simple: Engage students’ hands in the process, and their minds will follow. Many of the K.O.S. students went on to earn college degrees, thus disproving the “unteachable” label.

Today, K.O.S. consists of a combination of original and new members. In 2009, CPNAS engaged Rollins + K.O.S. in creating a piece based upon Darwin’s On the Origin of Species. During their research, the members saw Darwin’s sketch of the “tree of life” and decided to make it the visual building block of their work. Further research into modern biology revealed that a better metaphor for the evolutionary process might be a web rather than a tree. So, they created a stencil of Darwin’s original visual idea and used it to create a web-like form over a grid of pages from On the Origin of Species. Although the artwork does not reflect a precise scientific illustration of the evolutionary process, it does represent the concept of how an idea forms and evolves as new information is uncovered.

**B E N  V O L T A**

CPNAS later worked with one of the K.O.S. members, Ben Volta, on another project. Volta has cultivated a creative process of his own, working with students in Philadelphia. In 2010, Volta encouraged his students to research the Academy’s website featuring biographies of outstanding African-American scientists. With Volta’s guidance, the students created artwork based upon these biographies. The students created 19 individual portraits, each containing visual representations of the scientists’ work along with a student’s own silhouette. The inclusion of the students’ likeness encouraged them to imagine themselves as the generator of great ideas. The group also collaborated to create Catalyst Collider, a larger piece containing information from the individual research projects (historicalcatalysts.blogspot.com).

The work of contemporary artists such as Orrico, Rollins, and Volta represents far more than mere illustration or art in service to science. Their processes are a creative arc of inquiry allowing both personal and cultural relationships to their subjects to surface. Collaborations between science institutions and artists should embrace epistemological differences to create projects that are unique and innovative. Audiences can only benefit from the results. ■

**J D  T a l a s e k  (jtalasek@nas.edu) is director of Cultural Programs of the National Academy of Sciences in Washington, D.C.**
Bringing Art and Science Together

By Suzanne McCaffrey and Angela Seals

At Children’s Museum of Pittsburgh, artworks and art making that draw on aspects of science are an integral part of visitor experiences. Our visitors benefit by learning and creating in the fluid space where the two fields meet, where logic and fact blend with imagination and whimsy.

“We’re drawn to artists who try to discover how things work in the world and the beauty found in that discovery,” says Jane Werner, the museum’s executive director. “We believe that artists and scientists are using very similar processes, questioning their model of the world, which prompts the visitor to do the same.”

COMMISSIONING ART

We bring art into the museum in many ways, one being commissions of local and national artists. Artist Amanda Long’s work typifies the blending of art and science with installations that capture visitors on video and manipulate their images through additive light mixing and time staggering (White Light, Silly Faces, Motion Machine; see the photo on page 43 and the video at vimeo.com/29115056). In a math-based artwork, toy inventor Dick Esterle transformed our rotunda with 890 strands of pink and orange surveyor’s tape suspended 30 feet (9 meters) in the air to define a geometric form (more light). (See the photo on page 21.)

Artist Ned Kahn (see the sidebar on page 43) created the façade of our building from 40,000 acrylic flaps that flutter and ripple to make wind movement visible (Articulated Cloud; see the video at nedkahn.com/wind.html). Another artwork that provokes experimentation and questions is Text Rain by Camille Utterback and Romy Achituv. In this interactive video installation, virtual letters fall onto a live video image of visitors who can “catch” and “lift” the letters to create words and phrases. (See camilleutterback.com/projects/text-rain.)
HOSTING ART MAKING

The museum offers two artist residencies that have attracted many artists who are informed and inspired by science. Since 2007, Tough Art has provided summer residencies for a total of 22 artists. Each artist creates a piece for the museum with visitor input and testing on the floor for suitability and durability. For example, Rick Gribenas combined sound moments with LED light installations in An obscured neutral moment, and Matt Mets created Ferrous Wheel, a large rotating wheel where magnetic disks trigger musical notes.

We are hosting a FINE Artist Residency for three years (2009–12) with more than 25 artists who create artwork with visitor input and hold workshops on a particular art technique. Ceramicist Junji Miyazawa, who sculpts and creates with clay from local soil, taught kids to use a pottery wheel and brought in a geologist to speak about Pittsburgh geology and sedimentology. Wade Kramm held fascinating sessions experimenting with scale, mirrors, and visitors’ shadows. Amisha Gadani worked with children to make animal costumes from fabric and recyclables and taught them about animals’ phenotypic differences.

INVITING VISITORS TO CREATE

In October 2011, the museum opened MakeShop in collaboration with Carnegie Mellon University’s Entertainment Technology Center, Pittsburgh, and the University of Pittsburgh Center for Learning in Out-of-School Environments. This exhibit lets visitors work and discover alongside local artists, hackers, and inventors to make things with electronics, sewing machines, and woodworking tools. We also held our first Mini Maker Faire (a grassroots do-it-yourself event held in cities worldwide) that included many projects combining art and science, such as mobiles with solar-powered LEDs and songs played by MIDI-controlled train whistles.

MAKING IT WORK

Integrating artists and art-making into your museum takes some planning. Key steps include:

• Creating a framework: Determine your goals (e.g., adding variety, reaching a new audience, generating revenue) and program format (e.g., residency, workshop, camp). Establish a budget, including adequate artist stipends, supplies, and documentation.

• Finding funding: Allocate for commissioned works in your annual budget. Consider nontraditional grants and sponsors.

• Finding artists: Ask staff, friends, and collaborators. Put out a call at local universities, arts councils, guilds, and festivals.

• Choosing artists: Understand the artist’s creative focus and fit with your program. Seek personalities that work well with your audience. Lay out a selection process.

• Providing structure: Create a timeline, schedule, and templates for contracts and documentation.

• Promoting the program: Use your museum’s communication channels and those of the artist. You should also consider how to test artworks and art-based exhibits and programs with your audience. At our museum, artists and staff test on the floor with visitors to determine the most engaging and educational presentations. Location is also significant. Our audience interacts more with artwork when they “bump” into it rather than encounter it in a gallery, so we intersperse pieces throughout the museum—in an entryway, in a hallway, on a ledge in the café. In one piece, visitors trigger recorded children’s voices as they walk up a central staircase (Temperamental Stairs by Agnes Bolt and Arthur Jones).

In many ways, integrating art and science into the museum has followed an organic path, leading us and our collaborators through successes, failures, and surprises. Our most important piece of advice is to be open to learning from artists. The results are not always what you expect, but they are often inspiring for the creators, staff, and visitors.

Suzanne McCaffrey (smccaffrey@pittsburghkids.org) is director of new media and Angela Seals (aseals@pittsburghkids.org) is program manager at Children’s Museum of Pittsburgh.
In one of my first long conversations with Frank Oppenheimer, physicist and founder of San Francisco’s Exploratorium, I asked him to tell me about his cosmic ray balloon experiments of the late 1940s. He described how some of the mathematics of quantum physics suggested that there might be this interesting radiation coming from space, but it would get absorbed by Earth’s atmosphere. Frank quickly embraced the task of building a cosmic ray detector that would be carried to the upper edges of the atmosphere by a helium balloon to find out if this radiation was real.

Frank described the mixture of tedium and anticipation that went into building the detector, the excitement of the balloon launch in the desert, the process of tracking the balloon as it reached the edges of the atmosphere, and then the drama of chasing the falling detector by pickup truck and recovering it, dented but intact, from a farmer’s field. He then described how his heart thumped as they extracted the data and realized that cosmic rays are indeed real. He said it felt like they had opened a whole new window into nature.

Before I met Frank, I had spent a number of years creating static sculptures inspired by the ideas and metaphors of science. After hearing about his balloon experiments, all of my previous artworks seemed trivial. I wondered if it would be possible to create an artwork that had a tiny fraction of the drama and excitement of Frank’s experiments. I have spent the last few decades trying to realize this goal.

I have developed a body of work inspired by atmospheric physics, geology, astronomy, and fluid motion. I strive to create artworks that enable viewers to observe and interact with natural processes. My artworks frequently incorporate flowing water, fog, sand, and light to create complex and continually changing systems. (See nedkahn.com.) Many of these works can be seen as “observatories” in that they frame and enhance our perception of natural phenomena. I am less interested in creating an alternative reality than I am in capturing, through my art, the mysteriousness of the world around us.

THE CONFLUENCE OF ART, SCIENCE, AND NATURE
By Ned Kahn

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Ned Kahn (nedkahn@earthlink.net) is an artist in Sebastopol, California. In addition to Children’s Museum of Pittsburgh, Kahn’s work appears at other ASTC-member institutions, including the American Museum of Natural History, New York City; the Exploratorium, San Francisco; the Huntington Botanical Gardens, San Marino, California; the Museum of Life and Science, Durham, North Carolina; and Phaeno, Wolfsburg, Germany.
ASTC’s staff and board wish to thank our Corporate Partners for their leadership and generosity. We are truly grateful for their visionary support.
The Miami Science Museum, Florida, has received a $10 million pledge from the John S. and James L. Knight Foundation for its new facility, which will open in 2015 as the Patricia and Phillip Frost Museum of Science. A $20 million match is required.

The government of Flanders has officially approved a €6.85 million (USD 8.92 million) expansion of Technopolis, the Flemish Science Center, in Mechelen, Belgium. The Flemish government will support 45% of the cost of the expansion, the European Fund for Regional Development will contribute 40%, and sponsors will donate 15%. The expansion will open by March 2013.

Raytheon Company has donated $2 million to the Engineering is Elementary program at the Museum of Science, Boston, including $1 million for teacher training scholarships and $1 million to create new training hubs in Washington, D.C.; Phoenix, Arizona; and Huntsville, Alabama.

The Museum of Science has also received several U.S. National Science Foundation (NSF) grants:

- $1,736,685 to extend the Living Laboratory model, in partnership with Harvard University, to three new Hub Sites: the Maryland Science Center with Johns Hopkins University, Baltimore; Madison Children’s Museum with University of Wisconsin, Madison; and the Oregon Museum of Science and Industry with Lewis & Clark College, Portland.

- $49,754 to conduct a workshop about the societal implications of science and technology in partnership with Arizona State University, the Woodrow Wilson International Center for Scholars, the Loka Institute, and Scienceforcitizens.net.

NSF has awarded $1,578,911 to the Exploratorium, San Francisco, and the Museum of Life and Science, Durham, North Carolina, to develop the Science of Sharing project, which will create new ways for visitors to experiment with social psychology.

Google has contributed $1 million (USD 1.3 million) to Science Gallery, Dublin, Ireland, to support the Global Science Gallery Network, which will launch in July.

The New York Hall of Science, Queens, in collaboration with the Tufts Center for Engineering Education, the Learning Games Network, and New York City departments of education and of parks and recreation, has received a $499,998 NSF grant to create two science games about frictional force and linear motion.

The U.S. Institute of Museum and Library Services has awarded 21st Century Museum Professionals Grants totaling $1,989,953 (matched with $2,414,685 of nonfederal funds). The following ASTC members were among the recipients of the 10 grants:

- Balboa Park Cultural Partnership (including the Reuben H. Fleet Science Center and the San Diego Natural History Museum), San Diego, California: $165,000 (matching amount: $166,045) for 25 workshops and two symposia to provide professional development for museum staff and volunteers.

- The EcoTarium, Worcester, Massachusetts: $308,169 (matching amount: $309,460) to work with the ECHO Lake Aquarium and Science Center, Burlington, Vermont; Children’s Museum and Theatre, Portland, Maine; and the Discovery Museums, Acton, Massachusetts, to create a community of practitioners with knowledge of exhibit design for family learning.

- The Huntington Library, Art Collections, and Botanical Gardens, San Marino, California: $162,332 (matching amount: $188,670) to present workshops and seminars to improve the exhibition development skills of informal educators.

- Pacific Science Center, Seattle: $375,508 (matching amount: $505,987) to expand the Portal to the Public Guiding Framework to 15 informal science education institutions.

The Chatham Marconi Maritime Center, Massachusetts, is the recipient of a $100,000 capital donation from Ericsson Inc. for its future educational wing. In addition, the center has received $75,000 from the Verizon Foundation to partner with the MIT Club of Cape Cod and the Chatham Public Schools to develop curriculum and teacher training materials on communications, engineering, and design.
Picture a steaming air hockey puck spinning in a circle while floating in midair. This strange vision resembles a phenomenon demonstrated by Tel Aviv University’s Superconductivity Group at the 2011 ASTC Annual Conference in Baltimore last October. The “floating puck” was in fact a crystal wafer coated with a thin layer of ceramic material and cooled to -301˚ F (-185˚ C). At that point it becomes a superconductor, conducting electricity without resistance or energy loss—unlike the copper wires often used in electrical devices, which inefficiently cast off some electricity as it flows through.

Although superconductivity was discovered a century ago by Dutch physicist Heike Kamerlingh Onnes, the researchers at Tel Aviv University were the first to create a thin superconductor using high-quality materials. They also discovered that the improved features of this new applied superconductor enabled it to levitate.

The result, called quantum levitation, looks like a scene in a futuristic film, perhaps explaining why a video of the demonstration ([www.astc.org/blog/2011/10/26/quantum-levitation](http://www.astc.org/blog/2011/10/26/quantum-levitation)) went viral, earning 5 million views within a week. Tel Aviv University physicist Boaz Almog, who is heard explaining the phenomenon in the video, talked with Dimensions about superconductivity’s past, present, and future.

**How does it feel to be an overnight internet sensation?**
Quite surprising, but it’s nice. The attention is very good for us. We get the chance to show the public what superconductivity is.

**Why are so many fascinated by quantum levitation?**
I think mainly because it’s surprising. You don’t expect things to levitate. It’s something out of science fiction. When you see it your eyes just pop, as people have said to me.

**Can you explain how this works to a layman?**
We have a thin layer of superconductor, and when you expose it to magnetic fields, it locks itself in the air and prevents the magnetic fields from moving around. It does that just by driving currents inside of it, which is possible because it’s superconducting, and there is no energy loss.

**How did attendees of the ASTC Annual Conference react when they saw it?**
It was two days when we didn’t stop talking and demonstrating. They were all just amazed. They tried to touch it and put their fingers beneath it to make sure it really levitates. It was fun to see the interaction.

**On the Superconductivity Group website ([www.quantumlevitation.com](http://www.quantumlevitation.com)), you offer on-site presentations. Have those been in demand since the video?**
We’ve had quite a large demand—actually, an overwhelming demand. But we’re pleased that people want to see superconductivity. Many science museums want this demonstration so they can show young people, the public. [Superconductivity is] quite an old phenomenon, discovered in 1911. And still if you ask someone from the street, they don’t know what superconductivity is, and that’s not good for science.

**What else do you have in store with your work at Tel Aviv University?**
Ten years from now, we hope to have made wires out of superconductors, and then the possibilities are limitless—you can use them for [levitation], power cables, magnets, all sorts of electronics. There are lots of areas where you can benefit from superconductors.

For a podcast and full transcript of this interview, visit [www.astc.org/blog/category/astc-dimensions/q-and-a/](http://www.astc.org/blog/category/astc-dimensions/q-and-a/).
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