Exploring New Worlds:
Digital Media, Gaming, and Learning
of star power

EWW!
WHAT'S EATING YOU?

Featuring famed comedian
Carrot Top

Also presenting: Tony Hawk | Rad Science | CSI: Crime Scene Insects | Glow: Living Lights | It's a Gas!

exhibit
IQ
Traveling Exhibitions
Exhibit Development & Production
Museum Planning & Design

www.exhibitiq.com | 877-238-2846 | info@exhibitiq.com
features

24 Learning Labs: Transforming Youth from Digital Consumers to Creators
By Margaret Glass

29 Designing Digital Interactive Experiences that Promote Learning
By Leilah Lyons

34 Virtual Worlds: Avatars as Avenues to Advance Science Learning
By Lindsay Bartholomew and Judy Brown

38 Reinventing Dome Production for Community Storytelling
By Dave Pentecost

42 Legs, Not Fingers: Why Physical Games Are a Better Bet for Museums than Digital Projects
By Margaret Robertson

47 Games and STEM Education: Building Knowledge Through Play
By Jodi Asbell-Clarke

departments

5 FROM THE CEO
“the company we keep”: help us gather the stories of their museum experiences

6 INBOX
letter to the editor

6 SPOTLIGHTS
MoMath and more

10 NOTES FROM ASTC
introducing the new “Our Boards in Action” column—plus, ASTC celebrates 40 years

17 PEOPLE
staff changes and honors

18 WHAT WE LEARNED
trends and truths at ASTC 2012

53 GRANTS AND AWARDS

54 Q&A
Anissa Ramirez on science evangelism

Cover: Youth avatars explore an underwater environment through Digital WAVE, a program at the Miami Science Museum, Florida. Through real and virtual world experiences, Digital WAVE youth learn about the impacts of climate change on South Florida’s coastal environments. Image courtesy Ted Myers and Isabel Leeder, Miami Science Museum.
Progressive Museum Practice: John Dewey and Democracy

By George E. Hein
Left Coast Press

Progressive Museum Practice: John Dewey and Democracy is a historically relevant book that delves into John Dewey’s influence on museum practice, as well as into the significance of museums in fostering democracy and education. If you want to learn about this important aspect of museum education history, this is a must-read!

#165
ASTC members: $28
Nonmembers: $33

Visit www.astc.org/pubs to order.
“The Company We Keep”: Help Us Gather the Stories of Their Museum Experiences

The ASTC office in Washington, D.C., is only a few Metro stops away from the National Library of Congress, which houses among its treasures a compilation of oral and written testimonials from those who have witnessed history. Testimonials personalize events; they bind the presenters and listeners through common thoughts and feelings. Stories are much richer through first-hand telling.

In thinking about these historical testimonials, it occurs to me that so many fascinating individuals have passed through the doors of our science centers and museums and experienced so much. If we are judged by the company we keep, then we are no doubt judged favorably for the company of so many curious and inspired folks who have chosen to spend their precious time with us.

Too often and too easily, we refer to these knowledge seekers in generalized numerical terms more associated with revenue streams and statistical trends. Though the numbers are indeed impressive, we should remember that these are individuals who have consciously selected science, however briefly, as their domain of interest. And their visits to our institutions often yield new experiences and lasting memories. For some, science center visits inspire lifetimes of exploration, satisfaction, and even significant contributions to the global good.

ASTC would like to translate these personal experiences of our visitors into a collective expression of the inspirational value of our entire field. To emphasize this point, we are particularly eager to obtain testimonials from the “high achievers” in our society who can trace their interests, and maybe even their successes, back to profound science center and museum experiences.

Anthony (Bud) Rock (brock@astc.org) is ASTC’s CEO. Visit www.astc.org/blog/category/ceo to read more From the CEO editorials.

If you know individuals who would be willing to share such testimonials for our wider communications efforts, please send their names and contact information to yourstory@astc.org, or ask that they do this themselves. We will reach out to them in brief, recorded telephone interviews. It is our hope that you will give some thought to those whose testimonials might carry the most power and weight.

To start us off, here is a quote drawn from a testimonial by actor and writer Kate McGroarty, reflecting on her experience living at Chicago’s Museum of Science and Industry for a month in 2010: “I learned that science is beautiful, engaging, and just about everywhere. It amazes me, intrigues me, and excites me. I’m sure this is the beginning of a lifetime relationship with science and everything that comes along with it.”
As a partner on innovative Urban Transitions and Aridregion Hydrosustainability (IUTAH, www.iutahepscor.org)—a (U.S.) National Science Foundation–supported project focused on collaboration and capacity building for understanding and managing water in Utah, I appreciated your focus on water in the January/February 2013 issue of Dimensions.

In Lucilla Minelli’s article, “Building Peace and Sustainable Development Through Water Cooperation,” I was particularly drawn to the message that “water cooperation helps preserve water resources and protect the environment.” Through their expertise as conveners, communicators, and educators, museums can play an important role in sharing scientific knowledge and data alongside exchanges of water management strategies.

I also enjoyed Stephen Pizzey’s piece, “Build a Water Exhibit and They Will Come.” As someone who works in a museum that is immersed in place, I was glad to see the importance of linking experiences with water to the world around us. We, too, have seen an overwhelmingly positive response to our water exhibit, located at the center of our Land gallery. Surrounded by sweeping images of southern Utah and the sandstone that is prevalent in this region, visitors are able to visually and physically explore the phenomenon of erosion and how it shapes our environments.

Finally, Ling Ling Chew’s article, “Bringing Youth’s Ideas About Water to Rio+20,” serves as an important reminder that youth can and do have a voice in important issues like water. Valuing their input by giving youth an authentic place at the table is critical; many museums are poised to do this through programs initiated in the 1990s through ASTC’s Youth Achievement Through Learning, Involvement, Volunteering, and Employment (YouthALIVE!) initiative. Kudos to ASTC for being a fabulous role model and driver of this work!

Madlyn Runburg, director of school programs, management team and chair of external engagement, IUTAH Natural History Museum of Utah, Salt Lake City

Send letters to the editor to dimensions@astc.org (subject line: Inbox). Include your name, title, and institution. We reserve the right to edit letters for publication.
THE TRUTH ABOUT MATH

“Math is fun, beautiful, and important to getting a really good job in today’s world,” says Glen Whitney, founder and executive director of the 19,000-square-foot (1,765-square-meter) Museum of Mathematics (MoMath), which opened in New York City on December 15, 2012. But many people think math is boring, hard, and even scary. MoMath, North America’s only museum devoted solely to mathematics, has set out to dispel those misconceptions and reveal the wonders of math. More than 30 hands-on exhibits encourage physical interaction and provide “Aha!” moments of discovery. Although targeted primarily toward middle school students, the exhibits are designed to engage visitors of all ages.

At the Mathanaeum, visitors can design their own three-dimensional shapes and even build them using a 3D printer. In Harmony of the Spheres, they can touch glowing spheres to make music move through space, revealing the mathematical relationships among chords. Human Tree illustrates the concept of fractal geometry by projecting images of visitors’ bodies as tree trunks and branches. As visitors move, infinitely smaller versions of themselves branch out. Visitors can also ride a square-wheeled tricycle on a bumpy track and have a surprisingly smooth ride. Why? The track is made of catenary curves (think of the shape of a hanging chain, upside-down) that keep the wheel axles level. Or, visitors can visit the Enigma Café, where the menu features games and puzzles instead of coffee and pastries.

MoMath took four years to plan and build. The highly collaborative design process started with hundreds of ideas submitted by mathematicians worldwide as well as the internal design team. The building renovation and exhibits cost $15 million. A variety of corporations, foundations, and individuals—including Google, Oppenheimer Funds, and Simons Foundation—provided $23 million in funding. The remaining funds will be used to operate the museum for the next several years. —Sharon Barry

Details: Cindy Lawrence, associate director and chief of operations, info@momath.org, momath.org
DOWN BY THE RIVERFRONT

On October 20, 2012, after a dozen years of planning and with the collaboration of eight local organizations, the Peoria Riverfront Museum opened to the public in Illinois. The nearly 80,000-square-foot (7,430-square-meter) museum is an expansion of the Lakeview Museum of Arts & Sciences, which had operated since 1965. Like the Lakeview Museum, the Peoria Riverfront Museum takes an interdisciplinary and playful approach to learning. Its mission is to inspire lifelong learning for all, connecting art, history, science, and achievement through collections, exhibitions, and programs.

“With the new facility, we have greater opportunities to serve more ages—and on a larger scale,” says Kate Schureman, senior vice president of programs. The museum features several exhibition galleries—The Illinois River Encounter, The Street, Collections Gallery, Discovery Worlds (with sections for early childhood learners and school-age children), and a gallery for traveling exhibitions—as well as a digital planetarium, a digital 3D theater, and a center for testing sports and academic skills.

Throughout the $86.7 million museum, science activities are interspersed with exhibits on art and history. The Illinois River Encounter, for example, covers the river’s natural and human history, and includes an interactive stream table where visitors can experiment with the effects of erosion and deposition. In The Street gallery, which follows 300 years of Peoria history, kids can design cars and, through trial and error, learn how mass and aerodynamics affect speed. The museum plans to change its exhibits and programs regularly in order to encourage return visits. —Sharon Barry

Details: Susan Bergschneider, public relations and social media coordinator, info@peoriariverfrontmuseum.org, www.peoriariverfrontmuseum.org
Everything comes to an end—life, civilization, even one day the universe. Last March, a year after the Great East Japan Earthquake of March 11, 2011, the National Museum of Emerging Science and Innovation (Miraikan) in Tokyo opened a special exhibition about endings. The End of the World: 73 Questions We Must Answer encouraged visitors to engage in reflection and dialogue about a variety of endings in order to decide what is important to them and how humans should coexist with science and technology. Museum staff hoped that this exploration of endings would lead to hopeful beginnings. The special exhibition proved popular, and The End of the World is now a traveling exhibition.

The 73 questions, each guided by a scientific topic, are organized into four sections. Unanticipated Endings focuses on calamities that strike unannounced, such as earthquakes, volcanic eruptions, illness, and terrorism. Visitors explore the limits of scientific prediction and compare maps to answer questions such as: Where is the safest place in the world? In My End, visitors calculate the number of times they will perform various activities over the rest of their lives. The End of Culture features a chronological display highlighting changes over the past 4.6 billion years. It asks whether humans have lost anything as a result of technological advances, and what we can each leave behind. In The End of the Story, visitors reconfirm that every story begins with an ending, and contemplate their own future.

The government-funded exhibition is about 7,535 square feet (700 square meters) in size, depending on how the displays are arranged. Host museums can decide not to use all 73 questions, or to integrate their own displays related to other topics. —Sharon Barry

Details: Tamami Osaki, traveling exhibitions, outreach@miraikan.jst.go.jp, www.miraikan.jst.go.jp/en/spevent/owari/
NEW GOVERNING MEMBERS APPROVED

The ASTC Board approved two new Governing Members in October 2012.

For more than 124 years, the Bernice Pauahi Bishop Museum, Honolulu, has presented a broad array of science disciplines through exhibitions, public and school-aged programs, and outreach programming. With 177 full-time staff and a $10.6 million budget, the museum operates a campus with 209,000 square feet (19,420 square meters) of building space. The museum also manages the Amy B.H. Greenwell Ethnobotanical Garden on the island of Hawaii.

The mission of the Macao Science Center, Macao S.A.R., China, is threefold: to promote science popularization and education among local adolescents, to establish a new landmark to complement tourism development in Macao, and to provide a regional platform for science education, convention, and exhibition. The science center achieves its mission through exhibitions, films, planetarium shows, and educational programs in its I.M. Pei–designed building. The center features a 62,430-square-foot (5,800-square-meter) exhibition center, a high-resolution 3D planetarium, and a multi-functional convention center.

THE VIEW FROM 40: ASTC CELEBRATES A MILESTONE

This year marks the 40th anniversary of ASTC’s founding in 1973. While we will be celebrating this milestone in a number of different ways throughout the year, we’re interested in hearing your thoughts about ASTC’s first 40 years—your reminiscences, your perspectives on how things have changed, and your predictions for the future of the Association and the field. We’d also welcome any photos you are willing to share from ASTC’s early years.

Please send your thoughts and/or photographs via email to lhoffer@astc.org, or via mail to Larry Hoffer, ASTC, 1025 Vermont Avenue, NW, Suite 500, Washington, DC 20005. Thanks in advance for helping us celebrate!

GET YOUR OWN FREE COPY OF DIMENSIONS

Did you know that all paid staff members at ASTC-member institutions can subscribe to the award-winning Dimensions magazine, free of charge? To activate your subscription, visit members.astc.org and choose the print or electronic edition. And if you’re already a subscriber, spread the word to your colleagues. Nonmembers are also welcome to subscribe; visit www.astc.org/pubs/dimensions.htm for details. Student rates are available.
ASTC’s Communities of Practice (CoPs) have been active in 2013, hosting webinars and planning for the year. In February, the Teacher Education Network (TEN) hosted a webinar featuring Martin Storksdieck and Alan Friedman on preparing science museums for the next generation science standards and the role museums can play in professional development support for teachers.

TEN, as well as the Visitors Services CoP, the Research and Development CoP, and the Public Engagement with Science CoP had several planning conference calls and online conversations in January and February. These CoPs, along with Advocates for Diversity, will be presenting sessions at ASTC 2013. Look for more information on these sessions over the coming months.

ASTC is excited to announce its newest CoP, Museum Screens. This CoP is focused on bringing together museum professionals and researchers working with giant and immersive screen productions. For more information, or to join this or any of ASTC’s CoPs, email profdev@astc.org.

COMMUNITIES OF PRACTICE NEWS

IT’S NOT TOO SOON TO GET READY FOR ASTC 2013!

Although ASTC’s 2013 Annual Conference—to be held in Albuquerque, New Mexico, October 19–22—may seem like a far-off event on the horizon, it’s sooner than you think. A great deal of work is already underway—a diverse menu of educational sessions have been finalized, keynote speakers are being booked, and numerous activities are being planned—all to ensure that ASTC 2013 is an unforgettable and valuable experience for all attendees.

For the first time, ASTC’s Annual Conference will be hosted by three institutions—Explora, the National Museum of Nuclear Science and History, and the New Mexico Museum of Natural History and Science—and the unique perspectives and influences of each will help to shape the conference experience. The conference will again offer many of the features enjoyed by attendees—numerous opportunities to connect with your colleagues from across the globe, educational sessions jam-packed with useful information you can put into practice upon your return home, a top-notch Exhibit Hall featuring the latest products and services to enhance your institution or company, and a Saturday night party that will boast triple the excitement this year, as it will be held at all three of our host institutions!

We’re adding some great new features this year as well, including:

• The Museum Open House Day (including Big Screen Day and the Digital Planetarium Demonstrations), which will now be held on Tuesday, October 22, and will be accompanied by an exciting public Science in the Park festival

• A brand-new Awards and Leadership Luncheon on Saturday, October 19, and a complimentary luncheon in the Exhibit Hall on Sunday, October 20

• Three keynote sessions—on Saturday and Sunday mornings and Monday afternoon, combined with ASTC’s Annual Business Meeting—featuring insight, inspiration, innovation, and ideas writ large over three days

• Monday’s Super Session Day—offering more educational sessions than ever before. This one day alone will be worth your registration fee!

Registration opens in mid-March. We’ll see you in Albuquerque!
notes from astc

CAISE INITIATIVE ON PRACTICE-AND-RESEARCH

Since November 2012, the Center for Advancement of Informal Science Education (CAISE) has been working to gather information about the breadth and depth of work in informal science education that addresses the connections between practice and social science research. Through a series of conference calls, an ASTC Connect online forum (see the archived forum at www.caiseconveningwiki.org), and an in-person convening on January 31 and February 1, CAISE has been investigating questions about what types of knowledge practitioners and researchers use when making decisions about their work, as well as exploring the kinds of considerations that would inform the development of a research agenda for the informal science education field.

CAISE is involving a broad range of professionals from informal science education sectors including museums, science centers, zoos and aquariums, broadcast media, cyberlearning, gaming, out-of-school time and citizen science programs, and academia in these discussions in order to better support professionals with resources and infrastructure, which will be disseminated in June.

To access these materials, view updates on other CAISE initiatives, and sign up for the monthly newsletter, visit the project website at insci.org.

Richard Hudson (right), director of science production at Twin Cities Public Television, chats with David Kanter, director of the Center for Play, Science, and Technology Learning at the New York Hall of Science, at the recent CAISE convening on practice-and-research. Photo by Julie Johnson.

WELCOME TO ASTC

The following new members were approved by the ASTC Board in October 2012. Contact information is available in the About ASTC section of ASTC’s website, www.astc.org.

SCIENCE CENTER AND MUSEUM MEMBERS

• Children’s Museum of Illinois, Decatur. The Children’s Museum of Illinois is a hands-on, interactive museum for children ages 3 to 12. First opened in 1990, the 15,000-square-foot (1,390-square-meter) facility provides educational opportunities in the arts and sciences.

• Children’s Museum of Virginia, Portsmouth. A $13 million expansion added 12,000 square feet (1,110 square meters) of new exhibit space to this museum, which reopened in 2011. The museum features a planetarium, gift shop, library, and exhibitions such as Pets and Vets, Safety Zone, and My Backyard and Beyond.

• Discovery Center at Murfree Spring, Murfreesboro, Tennessee. Discovery Center at Murfree Spring is a hands-on museum and nature center that inspires exploration, enhances learning, and builds confidence through diverse programs and exhibits. Chartered in 1986, the museum now serves 120,000 families in the community.

• Discovery Museums, Acton, Massachusetts. The Discovery Museums comprise two buildings on a 5-acre (2-hectare) campus. At the Children’s Discovery Museum, younger children learn while they play. At the Science Discovery Museum, visitors of all ages explore scientific concepts and hands-on creativity.

• Henderson Space and Science Center, Henderson, Nevada. This developing science center will provide interactive exhibits, space for experiments, and classroom areas in its 90,000-square-foot (8,360-square-meter) facility, to open in 2015. Henderson City council members are leading the effort for their southern Nevada community.

• Ideaventions, Oakton, Virginia. This storefront center with 2,000 square feet (185 square meters) of space and four laboratories serves children ages 3 to 13. While not a traditional science center with set hours for the public, the center offers workshops, afterschool enrichment programs, science camps, and themed parties.
notes from astc

Imagine Children’s Museum, Everett, Washington. Imagine Children’s Museum aims to make children’s lives better by creating a place where they can playfully learn. Open since 1993 and serving 236,000 visitors annually, the museum has an art studio, several science-based exhibits, and a rooftop climbing structure.

John E. Conner Museum, Kingsville, Texas. Housed on the campus of Texas A&M University–Kingsville, this museum is named for the school’s first history department chair. The museum’s collections are a record of the prehistory, history, and natural history of south Texas.


Unizul Science Centre, Richards Bay, South Africa. Founded by the University of Zululand’s Physics Department in 1982, this center features 17,220 square feet (1,600 square meters) of exhibit space with 300 interactive exhibits, a children’s museum, two classrooms, and an auditorium.

Preschool children from Nqeti Centre in Madlankala, South Africa, celebrate the opening of Africa’s first dedicated children’s museum, housed in Unizul Science Centre, in September 2011. Photo courtesy University of Zululand

New kindergartners enjoy active time at Raleigh’s Marbles Kids Museum during the annual Kickoff to Kindergarten celebration. Photo courtesy Marbles Kids Museum

SUSTAINING MEMBERS

Available Light, Salem, Massachusetts. This company is an award-winning lighting design firm. Clients include Connecticut Science Center, Hartford; Liberty Science Center, Jersey City; and the Children’s Museum of Houston, among others.

Historic Space Systems (HSS), Danville, Ohio. This company provides consultation, design, and fabrication services for exhibits of U.S. crewed spacecraft. HSS also creates interactive multimedia systems and consults on aerospace subjects.

OUR BOARDS IN ACTION

ASTC’s member institutions are tremendously diverse in size, scope, geography, and specialization. But what characterizes each is the extraordinary group of individuals who volunteer their time, vision, passion, and expertise to help guide the future—the institution’s board of directors. Each “Our Boards in Action” column will highlight a board member at an ASTC-member institution and will share their insights, not only about what motivated them to serve as a board member, but also about what science center executives can do to create good working relationships with their boards.

For our first “Our Boards in Action” column, we spoke with Jannik Johansen. A nuclear physicist by training and now a high school principal, Johansen has been chairman of the Board of Experimentarium, Hellerup, Denmark, since 1986. In 2012, he was awarded the H.C. Oersted Medal from the Danish Society for the Dissemination of Natural Science.

How did you get involved as a board member of Experimentarium?

When I was doing my Ph.D. in nuclear physics at the Lawrence Berkeley National Laboratory in California in 1976, I would visit the Exploratorium and the Lawrence Hall of Science with my wife and our then two-year-old son. Since then, I always wanted to start a science center in Denmark. In 1982, Esben Dragsted, a Danish lawyer, and I began setting up plans for the center—first a feasibility study, then a small fundraising campaign, and then a trial exhibition. Next we hired Asger Høeg, who has now been the director for 25 years! In 1991, Experimentarium opened to the public. When the board was constructed back in 1986, I ended up as chairman—probably because I was the only board member who was not the head of something and/or a millionaire. Sort of a compromise, you might say.

What should science center executives do to create good working relationships with their boards?

We need to know what is going on. There are nine members on our board, and we meet four times a year to oversee the budget and plans for development and future exhibits. I myself am in contact with our excellent director at least weekly, and often more than that, so it is a very close relationship.

In what ways is Experimentarium’s work meaningful to its community?

I would like to think that on a national level, Experimentarium has made a difference—that in an era when books mean less than when I was a teenager, we spread the understanding of science. Maybe some of our visitors become doctors, mechanics, engineers, teachers, or politicians with an understanding of why science is so important that it should not be left to just scientists themselves to have all the fun.

Where do you see Experimentarium headed in the future?

We plan to broaden our activities with more emphasis on spreading science news, training teachers, collaborating with local industries, and helping universities disseminate new knowledge. We are at the end of a major fundraising campaign, so we will be starting the construction of a new Experimentarium on the same site in the beginning of 2014, opening early 2015.

Do you have a board member you’d like to see profiled in a future “Our Boards in Action” column? Please send their name, position, and contact information to dimensions@astc.org (subject line: Boards).
unifiedfield™

inventing the future now

interactive & immersive experiences
mobile apps & social media
strategic media consulting

Eli Kuslansky
elik@unifiedfield.com
212.532.9595 ext 222
Blue Telescope uses technology, storytelling, and design to create engaging interactive exhibits and experiences. From multi-touch and mobile apps to games, quizzes, and social interactives, our innovative solutions use the latest technology to educate, communicate, and connect with your visitors.
On January 28, Emlyn Koster became director of the North Carolina Museum of Natural Sciences, Raleigh. He replaces Betsy Bennett, who retired in December 2012 after 22 years at the museum. Koster had most recently served as president and CEO of the Institute for Learning Innovation, Edgewater, Maryland, and previously led Liberty Science Center, Jersey City; the Royal Tyrrell Museum of Palaeontology, Drumheller, Alberta, Canada; and the Ontario Science Centre, Toronto.

Joe Hastings was appointed executive director of Explora, Albuquerque, New Mexico, in January. He most recently worked as a museum consultant based in Taos, New Mexico. Prior to that, he was executive director of the Don Harrington Discovery Center, Amarillo, Texas. In addition, he has experience as an exhibit developer and builder at the Technorama der Schweiz, Winterthur, Switzerland, and at San Francisco’s Exploratorium, where he also directed the Center for Museum Partnerships. Hastings is a Noyce Leadership Institute Fellow and a former ASTC board member.

Last September, Curt Simmons became president and CEO of the Science Center of Iowa, Des Moines, replacing Art Wittmack. During his six years as senior vice president and chief operating officer of the same institution, Simmons was active in the Iowa Governor’s Science, Technology, Engineering, and Math (STEM) Advisory Council’s working groups and is one of five people who implemented the Iowa Department of Education’s K–12 Next Generation Science Standards.

Jane Pickering has been appointed executive director of the Harvard Museums of Science and Culture, including the Harvard Museum of Natural History, Cambridge, Massachusetts. Pickering was formerly deputy director and director of public programs at Yale Peabody Museum of Natural History, New Haven, Connecticut. Before that, she served as director of the MIT Museum, Cambridge. She succeeds interim executive director David Ellis.

Effective November 5, 2012, William (Mac) Sudduth was appointed executive director of the Museum of Innovation and Science (miSci, formerly the Schenectady Museum), Schenectady, New York. Sudduth has led several museums through significant transformations, including the Kentucky Science Center, Louisville; the Museum of Life and Science, Durham, North Carolina; and the Science Museum of Oklahoma, Oklahoma City. He was also president and CEO of the Science Place, Dallas (now the Dallas Museum of Nature and Science) and director of the Fernbank Science Center, Atlanta. Sudduth replaces Teri Bordenave, who had served as interim executive director since February 2012.

Kelley Bass recently became CEO of the Museum of Discovery, Little Rock, Arkansas. He was formerly assistant dean for external affairs in the Donaghey College of Engineering and Information Technology at the University of Arkansas, Little Rock. Bass had been a member of the museum’s board of trustees for almost three years and served as board secretary. He succeeds Nan Selz, who retired on December 31, 2012, after almost nine years as the museum’s executive director.

Peter Nels Jacobsen and Stephanie Zervas joined the Duluth Children’s Museum, Duluth, Minnesota, last year. Jacobsen became the director of education in September, and Zervas became the director of membership, administration, and special events in May. Jacobsen has experience as an educator at the Denver Children’s Museum and in the classroom. Zervas was previously a contract provider doing bookkeeping for the Duluth Children’s Museum.

U.S. President Barack Obama has appointed Eric Jolly, president of the Science Museum of Minnesota (SMM), Saint Paul, to the National Museum and Library Services Board. Jolly will continue in his position as president of SMM while serving in this volunteer post, which runs through December 2016.

On January 28, Emlyn Koster became director of the North Carolina Museum of Natural Sciences, Raleigh. He replaces Betsy Bennett, who retired in December 2012 after 22 years at the museum. Koster had most recently served as president and CEO of the Institute for Learning Innovation, Edgewater, Maryland, and previously led Liberty Science Center, Jersey City; the Royal Tyrrell Museum of Palaeontology, Drumheller, Alberta, Canada; and the Ontario Science Centre, Toronto.

Joe Hastings was appointed executive director of Explora, Albuquerque, New Mexico, in January. He most recently worked as a museum consultant based in Taos, New Mexico. Prior to that, he was executive director of the Don Harrington Discovery Center, Amarillo, Texas. In addition, he has experience as an exhibit developer and builder at the Technorama der Schweiz, Winterthur, Switzerland, and at San Francisco’s Exploratorium, where he also directed the Center for Museum Partnerships. Hastings is a Noyce Leadership Institute Fellow and a former ASTC board member.

Last September, Curt Simmons became president and CEO of the Science Center of Iowa, Des Moines, replacing Art Wittmack. During his six years as senior vice president and chief operating officer of the same institution, Simmons was active in the Iowa Governor’s Science, Technology, Engineering, and Math (STEM) Advisory Council’s working groups and is one of five people who implemented the Iowa Department of Education’s K–12 Next Generation Science Standards.

Jane Pickering has been appointed executive director of the Harvard Museums of Science and Culture, including the Harvard Museum of Natural History, Cambridge, Massachusetts. Pickering was formerly deputy director and director of public programs at Yale Peabody Museum of Natural History, New Haven, Connecticut. Before that, she served as director of the MIT Museum, Cambridge. She succeeds interim executive director David Ellis.

Effective November 5, 2012, William (Mac) Sudduth was appointed executive director of the Museum of Innovation and Science (miSci, formerly the Schenectady Museum), Schenectady, New York. Sudduth has led several museums through significant transformations, including the Kentucky Science Center, Louisville; the Museum of Life and Science, Durham, North Carolina; and the Science Museum of Oklahoma, Oklahoma City. He was also president and CEO of the Science Place, Dallas (now the Dallas Museum of Nature and Science) and director of the Fernbank Science Center, Atlanta. Sudduth replaces Teri Bordenave, who had served as interim executive director since February 2012.

Kelley Bass recently became CEO of the Museum of Discovery, Little Rock, Arkansas. He was formerly assistant dean for external affairs in the Donaghey College of Engineering and Information Technology at the University of Arkansas, Little Rock. Bass had been a member of the museum’s board of trustees for almost three years and served as board secretary. He succeeds Nan Selz, who retired on December 31, 2012, after almost nine years as the museum’s executive director.

Peter Nels Jacobsen and Stephanie Zervas joined the Duluth Children’s Museum, Duluth, Minnesota, last year. Jacobsen became the director of education in September, and Zervas became the director of membership, administration, and special events in May. Jacobsen has experience as an educator at the Denver Children’s Museum and in the classroom. Zervas was previously a contract provider doing bookkeeping for the Duluth Children’s Museum.

U.S. President Barack Obama has appointed Eric Jolly, president of the Science Museum of Minnesota (SMM), Saint Paul, to the National Museum and Library Services Board. Jolly will continue in his position as president of SMM while serving in this volunteer post, which runs through December 2016.
what we learned

ASTC 2012 Through the Lens of One Science Center

By Frederic Bertley and Julia Skolnik

Through the ASTC Annual Conference, there exists a wonderful opportunity for two rather distinct experiences. The first, due to the sheer scope and breadth of the conference, is the chance to listen to and learn from thought leaders, experts, and practitioners in the science center and museum field. The second is equally rewarding: the opportunity for informal interactions that allow us to float ideas to and even commiserate with our like-minded colleagues from around the world.

As one of the oldest science centers in the United States, we at the Franklin Institute consider the ASTC Annual Conference our perennial pilgrimage. We typically gather a large contingency (thanks to competitive grants and conference and travel stipends) and leave Philadelphia bound for whichever city and science center will be our gracious host. With such a large group, Dennis Wint, our president and CEO, took the opportunity to create a challenge-assignment, and each year, he proposes a different set of questions to investigate through both formal and informal interactions at the conference. It is noteworthy that he participates in the assignment with us, and upon our return, we compile our findings into a report that is shared among all staff.

The questions for this past conference (hosted by COSI in Columbus, Ohio) focused on exploring how science centers can stay relevant in an ever-expanding digital world, while meeting the needs of their surrounding communities. Interestingly, there were no definitive answers, but there was consensus on some truly remarkable directions. Here are some of the trends that were being discussed at ASTC 2012:

1) Science centers have a real impact on science literacy.

While we all “know this,” this conversation at ASTC 2012 revolved around data and evidence, as opposed to gut feelings and anecdotal stories. Interestingly, despite having a smaller marketing budget or reach than broadcast media and entertainment powerhouses, science centers have managed to command a significant level of the public’s attention.

2) Science centers are expanding their offerings into new spaces, both on site and off site.

Another prevalent theme throughout the conference was the trend toward creating customized and flexible experiences for an increasingly diverse visitor population, including maker spaces and learning labs. In addition, science centers are engaging in pub science and citizen science programs, many of which are hosted in community-based spaces. These types of programming give people a voice in shaping science experiences both inside and outside the walls of traditional science centers. They also move us from a service-provider mentality to a visitor-generated experience framework, where visitors create their own understandings of science across a variety of learning contexts. Interestingly, this aligns with best practices identified by science learning research in cultivating authentic inquiry-driven experiences.

3) Science centers are increasing their reach through web-based platforms and mobile devices, as well as multi-institution networks.

By offering web-enabled technology such as videoconferencing for professional development and student programs, science centers are able engage even more people in more places. Similarly, science centers are experimenting with how mobile devices and augmented reality (see photo above) can enhance and extend on- and off-site experiences. In addition, by participating

Continued on page 21
Join us at The National Conference this June to advance the agenda for change in STEM education, policy and workforce development. Leaders in business, education and government will collaborate to create an impact to fill jobs now and advance the future of the STEM workforce.

Reserve your place today.

The National Conference
June 17-19, 2013
Austin, Texas

www.USNewsSTEMSolutions.com
Looking for a **new** traveling exhibition?

Visit ExhibitFiles.org for the latest traveling exhibitions available for your museum. You’ll find exhibition listings, photos, floor plans, and more!

Contact Wendy Hancock at exhibits@astc.org for details, rates, and answers to all of your questions.

ExhibitFiles
exhibitfiles.org

Promote your exhibition worldwide with the new Traveling Exhibition online postings on ExhibitFiles.org!
Continued from page 18

in broad U.S.-wide networks such as Portal to the Public, Nanoscale Informal Science Education Network (NISE Net), and the National Girls Collaborative Project, science center professionals can make a larger impact while forming lasting partnerships with other institutions.

These trends are particularly relevant to the Franklin Institute as, like many of our colleague institutions, we are currently strategizing our next steps to better engage our surrounding communities. We have committed to an investigation of how digital media can be leveraged to expand the experience for the public. We have learned that allowing visitors to have individualized experiences is crucial to sustaining their interest. In addition, we believe that developing high-quality spaces both inside and outside the museum, coupled with digital experiences that enable children and adults to explore scientific concepts, will become increasingly relevant in science learning environments.

Following the conference, our institution was left with a few questions of our own: How do we augment the museum visitor experience and have visitors participate in our extended community and online spaces? How do we compete with progressively advanced in-home entertainment? What investment risks are we willing to take to better meet the needs of our visitors and the greater surrounding community?

Overall, the Franklin Institute found ASTC 2012 to be extremely informative. Through formal presentations and informal conversations, science center colleagues were willing to share their methods, successes, and shortcomings. The opportunity to trade lessons across institutions and speak candidly with colleagues was invaluable. In particular, ASTC allowed us to shine a light on the future of our institution. It was a great conference. Thank you, ASTC. Thank you, COSI.

If you would like to write about what your institution has learned from a project in exhibit development, education, finance, and/or operations, contact us at dimensions@astc.org (subject line: What We Learned).

Frederic Bertley (fberley@fi.edu) is vice president of science and innovation, and Julia Skolnik (jskolnik@fi.edu) is manager and curriculum specialist, both at the Franklin Institute, Philadelphia.
A Digital World

Digital media is increasingly present in our daily lives, as well as on the floor of the science center. In this issue, we look at how informal educators and designers are using digital media and gaming to create compelling, interactive learning experiences. Whether by tackling science-based challenges on a mobile device, designing their own digital dome productions, or gaming in the real world or a virtual one, audiences are using the flexibility of new technologies and the power of play to engage deeply with science.

The Building Is... encouraged players to interact with the building that houses Paris’s Gaîté Lyrique. As players engaged the building’s “senses” through various games, the building’s mood shifted, from melancholy to excited to elevated to lonely. Giant screens in the foyer gave aesthetic read-outs on how it was feeling. In this picture, it is feeling excited. Photo courtesy Hide&Seek
Today’s youth grow up in a digitally networked world. With cell phones, laptops, and tablets, via social media platforms, videos, and podcasts, they connect to each other and to their world like never before. Yet with only a few exceptions, the digital signal gets dropped at the door when teens go to school; youth get most of their exposure to new digital media outside of school.

This reality raises some important questions: How do youth learn to move across the digital landscape, choosing tools and platforms? Who are the adults that help to mediate this experience? What about teens in communities with a persistent digital divide? How do young people transition from being passive consumers of new media to becoming innovative thinkers and doers?
These are some of the questions behind the Learning Labs in Libraries and Museums (www.imls.gov/about/learning_labs.aspx), a program funded by the John D. and Catherine T. MacArthur Foundation and the (U.S.) Institute of Museum and Library Services (IMLS). The Urban Libraries Council (ULC) and ASTC collaborate to provide technical assistance to grantees and to help them form a national network.

The goal of the program is to support museums and libraries as vital community institutions where youth can explore their interests while developing 21st-century skills like critical thinking, creativity, and collaboration.

Since the Learning Labs program was announced in 2011, there have been two rounds of grant competitions that have resulted in 24 grants to museums and libraries across the United States. These awards support the planning and design stages for Learning Labs, intended to engage middle and high school–aged teens in youth-centered, interest-based, mentor-led, collaborative learning using digital and traditional media. This article provides an overview of the Learning Labs program to date, including a summary of related research and some snapshots of current projects.

FROM RESEARCH TO PRACTICE

The Learning Labs is a research-to-practice program, drawn from the MacArthur Foundation’s Digital Media and Learning (DML) initiative, which was established in 2006 to study the ways in which digital media are changing how young people learn, play, socialize, and participate in civic life. The research of Mizuko (Mimi) Ito of the University of California, Irvine, is central to the design principles behind the Learning Labs. Interviews and observations derived from a three-year ethnographic investigation of over 700 youth led Ito and her research team to identify three modes of participation that describe how teens engage with each other and with digital media.

“Hanging Out” describes the desire of teens to be with and socialize with their peers. Often when today’s youth get together, this contact involves digital connections—browsing social networks, instant messaging, or texting. “Messing Around” marks the beginning of a more deliberate engagement, perhaps purposefully seeking information on a specific activity, experimenting with something new, or starting to customize digital experiences. “Geeking Out” describes a more intense, focused mode of engagement. Interests become specialized, teens develop expertise in digital skills, and they may join or create social groups around these domains. Geeking out can include equally intense commitment to more traditional, offline pursuits.

These modes of participation, collectively termed HOMAGO, correspond to the kinds of learning contexts anticipated at a Learning Lab. Following the example of YOUMedia at the Harold Washington Public Library in Chicago (youmediachicago.org), Learning Labs try to include physical spaces that accommodate the modes of HOMAGO and are equipped with digital and traditional media to support youth’s self-directed learning.

The programs-in-planning encompass science, technology, engineering, and math (STEM); language, visual, and graphic arts; video and audio production; spoken word projects; maker spaces; and virtual worlds. But while activities may vary, the underlying design principles of these labs should be consistent. They are expected to include active experimentation and production, and be networked with other learning contexts within a community. Programs should be driven by the interests of the youth participants and relevant to them and their peers, yet linked to their intellectual growth and academic success.

Mentors are another key element to supporting learning in these spaces. The core set of characteristics for mentors includes expertise in new media, social/cultural capital as creators in their own right, basic pedagogy skills, and, perhaps most importantly, the ability to connect to and inspire youth while respecting their voices.

This set of design features firmly embeds the Learning Labs in Connected Learning (connectedlearning.tv), a broad model of learning emerging from the MacArthur Foundation’s research and related investments in a suite of programs including...
ideas. Each site is on its own trajectory with respect to piloting and implementing activities, training mentors, and seeking support for post-grant sustainability. Grant funding for the first cohort of sites runs until the end of June; the second cohort of awardees officially began on January 1. Because of this timetable, and the nature of these as planning grants, summary statements made about these sites now would be premature. Nevertheless, it is possible to spotlight a couple of public examples.

A HIVE POP-UP IN SAN FRANCISCO

The Learning Lab project at the San Francisco Public Library involves a team of partners: San Francisco’s California Academy of Sciences, KQED, and the Bay Area Video Coalition. While details of the physical space at the San Francisco Main Library are still in progress, the Learning Labs team held its first collaborative public event—the San Francisco Hive Pop-up, a two-day maker/hacker media jamfest for teens—in October 2012 at the Ortega Branch Library.
The New York Hall of Science Learning Lab in Queens hosts “teen hangouts” in the institution’s new Cognizant Maker Space (makerspace.nysci.org). At left, Jon Santiago (standing) from H-TINK (an educational services cooperative) advises teens on Arduino programming. Below, a student applies what he has learned. Photos by David Wells

The “Hive” label for this event comes from the fact that it involved a range of organizations—including such diverse partners as the San Francisco Public Utilities Commission, WritersCorps, and the Children’s Creativity Museum—united by a focus on youth and digital media. This model is similar to the Hive Learning Networks (hivelearningnetwork.org) in New York and Chicago, also supported by the MacArthur Foundation. All of the activities were transportable and installed on site for the event—hence the “pop-up” description.

The project’s Youth Advisory Board decided the theme (“Save the Earth”) and directed the kinds of activities to feature. These activities blended traditional creative skills with technology components, unified under an environmental message. Youth had the chance to experiment with video editing, claymation, 3D printing, and webpage development, and many participants uploaded videos of their creations to Tumblr (hivesf.tumblr.com).

The event gave the lab’s core team the chance to try out some new activities with their targeted youth, and helped to build relationships with other cultural organizations serving youth in the San Francisco area. A blog post about the Hive Pop-up by KQED’s Matthew Williams is available at education.kqed.org/edspace/2012/11/14/hivesf-a-maker-hacker-pop-up-media-jam-fest-for-teens/#more-3925.

A VIRTUAL LAB IN PENNSYLVANIA

The Da Vinci Science Center in Allentown, Pennsylvania, has a unique environment for its Learning Lab. The Virtual Studio lives on an educational island on the NewWorlds grid, a virtual world similar to Second Life, but with content appropriate for youth. The grid is open to Pennsylvania school students and teachers.

A pilot program took place in this virtual space during June and July of 2012, with a group of 15 teens participating in the Healthy Youth
Peer Education (HYPE) summer camp at nearby Muhlenberg College. Youth entered the Virtual Studio, created their own avatars, learned how to build architectural structures, and designed their own digital art creations. These installations are three-dimensional constructions that include photos, images, or other digital representations following the theme “The Best Part of Me.” A webinar recorded in December 2012 provides a “flythrough” visit to the Virtual Studio, with closeups and verbal descriptions of some of these digital artifacts (available at www.astc.org/about/videos/2012-12-14_%20DaVinciVirtualLearningLab.wmv).

Next steps for this site involve drop-in after-school events hosted at the Allentown Public Library, another project partner. This will provide an opportunity for a broader range of teens to experiment in the Virtual Studio, as well as to participate in additional activities of their own design. The location of the library, on the walking route between a large high school and residential areas, promises a high level of visibility and use by local teens.

How do science museums fit into today’s landscape of digitally mediated experiences for youth? The Learning Labs program allows participating grantees to explore this question, using the partnerships and resources they develop in the course of their planning periods. As they adapt to meet the unique needs of their own communities, Learning Labs in Libraries and Museums may provide new models for teen engagement, recognizing the challenges youth face as they connect to each other, identify and pursue their interests, and seek to become lifelong learners in today’s digital world.

ADDITIONAL RESOURCES
The DML Research Hub’s DML Central (resources about digital media and learning): dmlcentral.net.
Connectedlearning.tv: an affiliate website of the DML Research Hub, with community resources about Connected Learning.

Margaret Glass (mglass@astc.org) is ASTC’s program manager for professional development. David Smith (Da Vinci Science Center), Matthew Williams (KQED), Puja Dasari (California Academy of Sciences), and Jon Worona and Jennifer Collins (San Francisco Public Library) contributed to this article. U.S. science centers and museums are invited to participate in a related project, the National STEM Video Game Challenge; visit stemchallenge.org for details.
Designing Digital Interactive Experiences that Promote Learning

By Leilah Lyons

It is an exciting time to be an educational interaction designer for museums. With the recent explosion in new kinds of digital media technology, designers have newfound freedom to explore many different ways to engage learners and build understanding. Rather than needing to “fit” an interactive experience within a standard desktop-trackball-kiosk package, we have a range of digital tools at our disposal—from non-desktop input technologies (e.g., camera-based tracking of physical objects or visitor movements in the exhibit space, or the ability to embed sensors in objects to make custom controllers) to output technologies (e.g., large flatscreens or projectors) to combinations of input and output technologies (e.g., tabletops or mobile devices).

Yet undoubtedly, we can all think of a digital interactive we have encountered at a museum that was flashy and fun, but of questionable educational value. Akin to how “seductive details” (i.e., interesting but irrelevant content) can distract readers from the message of a text (Harp & Mayer, 1998), designers must be on the lookout for “seductive interactions” that might entice visitors, but which ultimately interfere with learning. In museums, there is the additional risk of getting visitors so engaged with digital media that they become disconnected from their companions, which interferes with social learning opportunities.

Designers find themselves facing the “Goldilocks” dilemma—finding a level of engagement that is enough to get visitors involved, but not so immersive that visitors lose sight of the content or their companions. Understanding how to get

Explainers at San Francisco’s Exploratorium test Malignancy, a game that requires visitors to work together to fight cancer cells. The game utilizes both individual mobile devices and a large shared screen. Photo by Sherry Hsi
engagement “just right” requires a design process that intentionally aligns the nature of the interaction with the nature of the content, and which preserves the social dynamics present in museums.

WHERE DO SEDUCTIVE INTERACTIONS COME FROM?
No educational designer sets out to do learners a disservice. Seductive interactions can find their way into digital museum interactives in two major ways:  

1. “Something borrowed” can make you blue.

Developing digital interactives is costly and time-intensive, and often requires museums to bring in external developers. Once an interaction design has been built and tested, there is a temptation to reuse it. Sometimes this can be perfectly appropriate, but the reality is that many development firms divide their time between commercial clients and museums. What might make shoppers happy may have nothing to do with what helps learners build understandings, or may simply not be a good use of a visitor’s time at a museum.

The problem of inappropriate borrowing can crop up even with custom-designed interactives. Designers often think in terms of existing interactive media conventions. For example, when considering how to motivate a learner to continue with an interactive experience, one might suggest using a scoring mechanism based on one’s favorite video game. This can be very effective, especially when the scoring mechanism is aligned with skills learners should master to understand the material (Gee, 2003), but far too often it can lead to mismatches between engagement and learning. For example, years ago, on a NASA website for children, I saw a game based on the card game Concentration, where players could flip pairs of images to find matches (e.g., images of rovers, rocks, etc.) While some kids do find this game engaging, it’s hard to make a case that any meaningful science content could be learned from it.

2. I have seen the enemy, and the enemy is US (Usability Studies).

Usability studies are often conducted during the development of a digital interactive to ensure that visitors will be able to figure out how to use it (i.e., its “learnability”) and to determine if users find it appealing (i.e., its “enjoyability”). These studies are critical—after all, no one will learn from a baffling or unenjoyable interactive. Where usability studies can lead one into trouble is when they are structured to take the opinion of visitors as the “gold standard,” as might be the case if a designer is following the principles of User-Centered Design (UCD) (Norman & Draper, 1986). (See www.w3.org/WAI/EO/2003/ucd for a take on UCD.) Learning is not, and should not be, an effort-free endeavor, but learners may rank an interface that challenges them to think lower than the one that does not. We must carefully structure usability studies so that learners give us feedback that strengthens the experience as a whole, and not just its usability.

LEARNER-CENTERED DESIGN OF MUSEUM INTERACTIVES

Learner-Centered Design (LCD) (Soloway, Guzdial, & Hay, 1994) is an elaboration on UCD, which acknowledges that learners are a different sort of population from standard users. With UCD, the typical goal is to make the task more seamless for users, whereas with LCD, the process begins by examining the learning goals and the current state of learner knowledge and designing the task and software tools accordingly. (See homepages.cwi.nl/~steven/sigchi/bulletin/1998.4/hsi.html for more on LCD.) The following are some LCD-inspired guidelines for designing effective learning experiences with digital media.

1. Know when to hold (the learner’s hand) and when to fold (the learner into the task).

LCD places special emphasis on making decisions about which portions of a task should be “scaffolded” (i.e., made more seamless), and which portions

Learning is not, and should not be, an effort-free endeavor.
In CoCensus, tested at Chicago’s Jane Addams Hull-House Museum, a Kinect camera changes the census data on display on a map of Chicago in response to the motions of people in the exhibit space. Each person "embodies" a different country-of-origin category (Italian, Indian, Polish, etc.) Photo courtesy Jessica Roberts

should intentionally require more active effort on the part of the user. Without this step, it can be too easy to accidentally streamline an interactive to the point where opportunities to learn are actually taken away. For example, users might give feedback that the titration component of a simulated chemistry experiment is too time-consuming. The designer might then opt to replace an interaction requiring a separate click for each drop from a pipette with a menu of three buttons representing different volumes of titrant to add. This change might make the interactive more usable, but it deprives learners from knowing what performing titration is like. Instead, the designer might automate a noncritical subtask, such as recording pH volume. Another option would be to swap out the simulated pipette with a simulated burette valve, thus speeding the interaction while preserving the essential task.

2. **You can afford it.**

Norman (1988), the researcher who pioneered UCD, appropriated a concept called “affordances” from visual perception research to describe how the appearance of interactive items can suggest how they might be properly used. The classic example of affordances is the design of a teapot—the position of its handle and spout suggests how it is meant to be held and poured. Software can have affordances as well—cues that suggest to the user how to use the interface. With LCD, designers use affordances to guide learners into interactions more likely to promote learning. For example, Mayer (2005) found that learners often struggle with absorbing critical details from educational animations, but their attention to detail can be increased by adding simple and prominent playback controls, which suggest that replaying the animation is a sanctioned activity.

3. **Give them a hammer, and they’ll see nails.**

Designers can help learners remain focused on the task at hand by choosing appropriate interactive technology. For example, for a green infrastructure urban planning simulation, I chose a tangible user interface (TUI)—an interface where users move and manipulate objects. To learn how the placement of native plant swales (gardens engineered to retain and infiltrate rainwater) can affect urban
flooding, learners arranged tiles representing swales on a table-sized map of an urban area. Our research showed preliminary evidence that TUIs helped learners explore spatial patterns more effectively than a desktop interface, likely because TUIs encourage users to manipulate the positions of objects and because they provide a physical anchor for learners’ attention that facilitates group discussion.

4. If it was easy, it wouldn’t be worth it.
Sometimes it is necessary to make certain interactions harder to help learners focus their attention and build a better understanding of a topic. For example, I designed an interaction to help learners understand how local-level behavior of entities like insects or cancer cells (shown in detail on individual mobile interfaces) could result in global-level effects like genetic drift or metastasis (shown on a large shared screen). The learners had to work to piece together the connections across the devices, and establishing these connections helped them to better understand the system.

5. Many brains make (learning) light work.
Digital media can also be used to support the
social interactions we know to be so important within museums. For example, by simply replacing desktop-based interactive kiosks with wall-mounted large displays, groups of visitors can participate vicariously, even if input is still provided by a single visitor via the classic trackball. Another way to encourage social interactions is to set up a situation of positive interdependence, where visitors cannot complete the task at hand alone. Giving users separate interfaces (e.g., mobile devices or touchscreens) and/or distinct roles to play can encourage information sharing and strategizing. (See #4.)

Science museums have always excelled at providing hands-on interactive experiences to visitors—so much so that digital interactives have often paled in comparison to their analog brethren. By focusing visitors’ attention and promoting social interactions, we can design digital interactive experiences that take advantage of the possibilities of digital media without sacrificing the high expectations visitors have for interactive experiences in museums. ■

REFERENCES

Leilah Lyons (llyons@nysci.org) is director of digital learning at the New York Hall of Science, Queens, and assistant professor of Computer Science and Learning Sciences at the University of Illinois at Chicago. More information about the author’s research and projects is available at www.cs.uic.edu/~llyons.
Virtual Worlds: Avatars as Avenues to Advance Science Learning

By Lindsay Bartholomew and Judy Brown

When young people visit a science museum, the exhibits are typically already created for them to enjoy and explore. When they visit a scientist’s laboratory or other professional’s workplace, they are on someone else’s turf. It’s not always easy for young people to make connections between what they learn and their own interests in order to help define the career they would like to pursue.

At the Miami Science Museum in Florida, we received funding from NASA, the (U.S.) National Science Foundation (NSF), and the (U.S.) National Institutes of Health (NIH) for projects that address the need to raise awareness of science, technology, engineering, and math (STEM) careers using virtual world technology. A recent NSF Innovative Technology Experiences for Students and Teachers (ITEST) project, Digital WAVE—Warming Winds and Water, was designed to address U.S. workforce needs in digital design, computer modeling, and advanced technology-intensive environmental science careers, including climatology and marine science.

The project focused on climate change impacts on South Florida’s coastal environments, including coral reef bleaching, hurricane intensification, and sea level rise. The target participants were youth from underserved communities, mainly from low-performing high schools. With this audience in mind, we developed Digital WAVE to include both real and virtual experiences, with the goals of increasing science literacy and awareness of STEM careers and creating robust virtual world resources.

THE ADVANTAGES OF A VIRTUAL WORLD

Virtual world technology allows participants to be immersed in a realistic, interactive 3D environment where they become the creator of their own experience. Before navigating through the virtual world, Digital WAVE participants created their own avatars. Each person’s avatar is personal—it may look like the creator, or it may be imaginary, like a guitar-playing unicorn. Additionally, multiple avatars can interact within a virtual world and feel the impact of a personal encounter, despite the fact that the real people they are interacting with may be from across the globe.

Digital WAVE participants met local scientists in person and also met scientists from around the United States and from other countries via their avatars. Through virtual worlds, youth with little background in a given area, or who have never had an opportunity to speak with a professional in a field that interests them, can meet scientists and ask questions in a way they may not be comfortable with in person. For example, when young people meet a scientist’s avatar while floating underwater next to a colorful coral reef, they feel as comfortable speaking to the avatar as they would with a friend in the real world.

In Digital WAVE, real world experiences inform youth creations in the virtual world. Here, youth are replanting mangroves at a coastal restoration site. Photo courtesy Lindsay Bartholomew, Miami Science Museum
THE DIGITAL WAVE PROJECT

From 2011–12, the Digital WAVE project engaged 161 high school students in grades 9–12. Participants met over 14 Saturdays and an intensive two-week summer session to develop digital design skills and learn about climate change. They went on expeditions into real environments to replant mangroves in coastal restoration areas; canoe through Biscayne National Park to learn about relationships among aquatic, coastal, and inland habitats; and visit science labs to meet local scientists and observe coral and sea slug research facilities. These real-world experiences then inspired their subsequent creations in the virtual world.

They created a variety of simulations and resources, including:

- interactive planes, vehicles, and factories spewing fumes to highlight the relationship between human activity and atmospheric and climatic conditions
- Everglades and coastal habitats with mangroves and native birds to underline the importance of protecting the environment from pollution and from saltwater intrusion due to sea level rise
- a coral reef with various coral species to showcase the issue of ocean acidification and warming waters
- an environmentally friendly house powered by rotating wind and water turbines.

To read more about the students’ work, visit www.miamisci.org/wave.

The project initially used Teen Second Life as its virtual world platform, but the Miami Science Museum is now hosting its own virtual world on a private server. The advantages are that it allows us to sustain our virtual resources beyond the grant period, provides a more secure virtual environment for youth, and enables us to further the goal of creating an ongoing and collaborative virtual community.

Our overall goal is to create a community where youth participating in museum programs all over the world can meet, communicate, and learn about STEM career pathways. We have submitted a proposal to NSF to partner with five museums that will use the virtual world resources created during Digital WAVE as well as create their own new simulations. With this network, we can promote communication and collaboration among youth at various museums.

EVALUATION FINDINGS

A third-party evaluator reported that, after participating in Digital WAVE, students had increased confidence in their technology and design skills—even those who considered themselves fairly tech-savvy at the outset. The vast majority of participants expressed strong concern about the pace and extent of climate change, and focus groups indicated that they were motivated to make personal changes, with some even committing to try to change others’ habits as well.
Nearly all participants stated that they plan to go to college, and although they were mixed on whether Digital WAVE influenced their career choices, they showed a heightened awareness of what it means to be a scientist and the types of science careers available. One participant said, “I’m more inspired to pursue a career that will help tackle climate change. They’ve exposed us to so many different careers. You can examine a cloud and that’s helping climate change in a small way.”

Most participants felt their Digital WAVE experience was more motivating, interesting, and relevant than school. A participant said, “[The canoe trip] was really fun, because that same week in school we were learning about mangroves, and in Digital WAVE we got to go out and see the mangroves. It was pretty cool.” In describing why they liked Digital WAVE, participants talked about:

- the nonjudgmental atmosphere
- being with a small group of motivated peers
- focusing on specific, relevant content
- the freedom to direct their own learning
- the hands-on experimentation and field expeditions
- the access to experts working on similar environmental issues “in real life”
- the skills and expertise of the instructors
- the lack of stress from grading.

Perhaps the most inspiring part of Digital WAVE is that these young people, many of whom have known a real world only of urban concrete, created their very own virtual worlds of coastal and underwater environments, with corals, mangroves, and environmentally friendly houses.

Lindsay Bartholomew (lbartholomew@miamisci.org) is science curator, and Judy Brown (jabrown@miamisci.org) is senior vice president of education, both at the Miami Science Museum, Florida.
Reinventing Dome Production for Community Storytelling

By Dave Pentecost

When the Lower Eastside Girls Club in New York City decided to include a 30-foot (9-meter) planetarium in our new community science and art center, we had a big idea—and a big challenge. Construction of the 30,000-square-foot (2,800-square-meter) Lower Eastside Girls Club Center for Community had not yet begun, we were just beginning to learn about producing digital content for a dome, and our commitment to hands-on media production with neighborhood girls meant that we needed to find accessible tools for digital storytelling.

Major construction of the center (www.girlsclub.org/building) was finished in late 2012, and we will open in September 2013 to continue and expand our afterschool and weekend programs for girls ages 8 to 18. We will also offer classes to local public school students and their families.
During construction, we began learning about hemispheric projection and the production of dome programs using a mini-dome workstation. With a digital humanities startup grant from the (U.S.) National Endowment for the Humanities, the Girls Club invented this workstation as an offline teaching and production system. It allows girls and staff to produce and preview content for the dome without needing access to a planetarium.

THE HARDWARE: A MINI-DOME AUTHORIZING SYSTEM
To start learning 3D production to create hemispheric projections at high resolution, we required a way to preview dome content in a low-cost system that fit in a classroom. We also needed to get quick results in an after-school setting, so we searched for real-time 3D tools. We wanted to build an entire preview and teaching system for $10,000 or less. The result is our mini-dome system, documented on the Domebase website (www.domebase.org) and available to any dome operator or 3D animation producer. The key components are:
- a 54-inch-diameter (137-centimeter) acrylic dome, originally built as a skylight for recreational vehicles; we ordered it online
- a high-definition (1920 x 1080 resolution) projector
- a fisheye lens, which we constructed from two digital single-lens reflex (DSLR) lenses in a custom bellows holder
- a MacBook Pro computer
- the Unity 3D game engine software, which is available as a free download (unity3d.com), although we bought the Pro version to get features needed for hemispheric projection
- 3D environments and characters, which are available online or can be created in mesh modeling applications
- speakers
- music software, such as Apple Inc.’s GarageBand or Logic software, or iPad music apps.

UNITY 3D AS A PRODUCTION PLATFORM
The Unity game engine allows the Girls Club production team to rapidly create a simple 3D world, and it gives the viewer the ability to navigate through that world from their point of view, as a player does in a typical video game. Our first tests created a simple prototype for a production we will develop for the full-size dome. The production will tell the story of a girl who lived in the first house on the Girls Club’s new site, when it was a shipbuilding area. With the Unity software and our mini-dome workstation, we created a simple riverfront setting with a clipper ship and docks. The experience of creating the prototype showed us the potential for historical storytelling in the planetarium. This type of production will augment our astronomy programs, which will be presented using other software.

Once the planetarium is complete, the presenter in the dome can lead the point of view or an audience member can interact with the projection to choose a path. Alternately, we can program a preset path and render the result frame by frame into a dome movie. Either way, we can test and tweak the program with quick feedback in the mini-dome workstation before committing to the final result for planetarium projection.

Using the Unity software as a dome production platform is not original with the Girls Club. The Elumenati, a dome systems and production company, has used Unity for its work in immersive museum exhibits, simulation systems, and data displays. The company has also created one of the key tools for enabling hemispheric projection of Unity content—a warping system or software fisheye camera called Omnity (www.elumenati.com/products/software/omnity).

Putting these tools into girls’ hands and inspiring further exploration is a first step toward personal, local storytelling—something that is still rare in institutional planetariums.
Another pioneer in this area is Paul Bourke, a professor at the University of Western Australia, who created a simple fisheye camera rig for Unity and made it available on his site (paulbourke.net/miscellaneous/donemirror/UnityiDome). With a fisheye “camera” within the game world and a fisheye lens for projection, any 3D environment made with Unity can fill a dome in proper perspective and surround the audience.

LEARNING AND MOTIVATION

Creating a 3D world is an empowering exercise for young production students. So far, we have held afterschool classes with two age groups—ages 11-12 and 15-16—and have taught 25 girls the basic techniques. In less than an hour, first-time users of the mini-dome system can build an island terrain, cover it with trees supplied as built-in assets by Unity, and navigate their point of view or a simple, third-person character through their created world.

We then look at how those trees and characters are built as 3D meshes, so the girls can begin creating their own 3D objects. To enable this, we introduce simple mesh modeling tools to the students. The free program Sculptris, by Pixologic (www.pixologic.com/sculptris), is an intuitive way to begin sculpting 3D shapes by pushing and pulling digital “clay.” Another simple, free modeling program is 123D, by Autodesk (www.123dapp.com/123D). Putting these tools into girls’ hands and inspiring further exploration is a first step toward personal, local storytelling—something that is still rare in institutional planetariums.

In our new building, we will have daytime visits from the six local public schools. We hope to reach every elementary student, both girls and boys, to give them a glimpse of the universe in the planetarium. However, our focus has always been on afterschool and weekend activities that open new possibilities for girls in the neighborhood. We are most successful when we present things in an open, fun fashion, rather than as another classroom lesson.

Using a game engine fits well with this approach. Students can learn 3D geometry, basic coding, game physics, and narrative strategies without the pressures of school. Working collaboratively to create a virtual world becomes a strong motivator for students to learn the necessary skills. We are all—teachers and students alike—studying online tutorials posted by Unity Technologies and many independent game developers to become more proficient at game creation. One particularly useful site is Unity 3D Student (www.unity3dstudent.com).

The girls who have gone through our classes to date will be the core group as we study more aspects of dome production, and they will become part of the production team when we begin creating for the full-size dome.

NEXT STEPS

With our vendor partners—the Elumenati, providing projection systems and Uniview astronomy software; Spitz, Inc., manufacturing the dome; and Walters-Storyk Design Group, designing the
audio systems—we began installing our full-size planetarium in early 2013. The planetarium will be the core of our overall science program, called the Lamarr Lovelace Labs after two women innovators we admire. (Hedy Lamarr’s method of coding radio transmissions in World War II formed the basis of modern wireless communications, and Ada Lovelace, a mathematical prodigy, is recognized as the first computer programmer.)

In addition, the dome will present personal stories, live performers, visualization experiments, and tales of Lower East Side New York’s culture and history. The new Girls Club center also has other media labs—video, photography, audio, 2D design—that will contribute to these dome productions. The planetarium will open to the public in the evenings to present astronomy shows, Girls Club productions, and collaborations with other artists and scientists.

On a formerly empty, T-shaped lot, a testament to the days of abandonment and demolition in our neighborhood, the Girls Club’s new building has appeared. On one facade, above a public café and teaching kitchen, are the words “Building Community.” On another, above a shining Airstream trailer recording studio, visible through a window, are the words “Lower Eastside Girls Club.” And on a third, below a semicircle hinting at the planetarium within, are the words “Reach for the Stars.”

Dave Pentecost (dave.pentecost@gmail.com) is director of technology at the Lower Eastside Girls Club (www.girlsclub.org) in New York City.

Girls work on a digital dome production in an afterschool class at the Lower Eastside Girls Club. Photo by Dave Pentecost

The East River waterfront set for the production about a girl who lived in the 1830s. The image was created in Unity and warped for dome projection. Image courtesy Dave Pentecost.
In a museum setting, designing for touchscreens can feel like an increasingly inescapable imperative. Screens—and the fingers that manipulate them—suggest a dynamic, interactive way to present science content. Hard experience, though, can suggest otherwise.

As a game design studio, we at Hide&Seek Productions (H&S, www.hideandseek.net), headquartered in London, are often approached by museums and institutions that want to leverage the power of play to help in their educational programs or marketing outreach. It’s work we’re passionate about, but it’s also work that has brought us into direct contact with some of the substantial hurdles that screen-based projects produce.

At the simplest level, they’re often expensive. Good quality code doesn’t come cheap, and digital projects often come with auxiliary requirements for animation or sound design that push the price up further. The legacy problems, including keeping up with system updates and new technical requirements, can be substantial. In addition, external suppliers can’t always guarantee availability for the bug fixes and community management that modern players expect. Finally, accessibility can present a meaningful problem. Relying on smartphones in people’s pockets often means excluding visitors with lower incomes, or overseas visitors who are nervous about incurring sky-high data charges.

In the last few years, many of us as experience designers have had to make the adjustments needed for a new generation shaped by the internet, video games, Facebook, and texting. It’s already commonplace to encounter an 18-month-old who can effortlessly navigate a smartphone, or a baffled 3-year-old who can’t understand why the TV doesn’t respond to touch. Nor is it just the very young; many of us have caught ourselves prodding at an ATM screen, forgetting momentarily that buttons are still a thing we need to deal with.

The Building Is... encouraged players to interact with the building that houses Paris’s Gaîté Lyrique through games designed to mimic the building’s “sense” Touch, inspired by the classic electronic game Simon, wended through an entire corridor and tested players’ memories and athleticism. Photo courtesy Hide&Seek
In the event you overcome these issues, however, you’re still left with a problem. The more engaging the content you’re able to deliver on your chosen screen, the more disengaged users can become from the environment around them. Well-designed experiences can mitigate against this (see the article beginning on page 29), but it’s a risk that always needs to be considered.

That’s the bad news. The good news is that there are games that avoid all of these problems. Games that cater just as effectively to a world where our expectations of playful, dynamic, interactive experiences have never been higher.

Over our five-year history, H&S has made and run physical games in major museums, galleries, and arts venues across the United Kingdom and abroad. A physical game is one that operates in the real world, rather than on a screen. We’ve played giant pass the parcel through the courtyards of the Victoria and Albert Museum (V&A), London; unleashed vicious trade wars in the National Maritime Museum, Greenwich, England; staged an after-dark alien invasion in the Science Museum, London; turned visitors to the National Museum of Scotland, Edinburgh, into minesweepers; and brought the building that houses Gaîté Lyrique, Paris, to life by building sense-based games that let players interact with its “nose,” “ears,” and “eyes.” Some of these games had substantial budgets and required staffing and built elements; some ran on nothing more than a bit of paper and the enthusiasm of the players. However, what they all had in common is that they drew on the following core principles.

In Invisible Mirror, one of the Tiny Games designed for London’s Southbank Centre, two players stood on either side of a concrete pillar. One struck a pose, and the other had to try to copy it, unseen, simply by asking 10 yes/no questions. Photo by Peter Law

Tiny Games, designed for London’s Southbank Centre, gave instructions to players through low-cost, vinyl floor mats, which designers could position in exactly the best spots for playing the games. Photo by Peter Law
1. The building is the platform.

Digital game designers spend their careers studying the platforms they design for—learning the tricks for getting the best performance out of a PlayStation 3 or refining the principles for iOS touchscreen control. As physical game designers, our platforms are the buildings we work in. Often our first step in creating a new game is studying an environment from a playful perspective, finding the gaming potential in a grid of tiles or a strangely placed pillar. Our Tiny Games project for London’s Southbank Centre built on exactly that principle, and proved a particularly powerful way to leverage a small budget in a big space. We installed large vinyl floor mats that invited passers-by to play “tiny games” based in the environment, such as moving around a plaza as if it were a giant chessboard, or trying to hold a conversation without saying any of the large yellow and pink words in an outdoor art installation.

2. The content is the content.

We all know how compelling a good story can be, but stories aren’t necessarily critical components of a play experience. Over the years we’ve seen dozens of concepts for museum games that told a good story but reduced the exhibits to little more than props. For us, a great museum game is one that deepens a visitor’s engagement with the exhibits. Frequent H&S collaborator Sophie Sampson ran a game at the V&A that asked visitors to find particular silhouettes throughout the gallery. Sometimes these were simply the outline of the object, but sometimes...
finding a match required visitors to discover an entirely new vantage point on an exhibit (or set of exhibits), leading them to see the items in a new light.

Similarly, our *Take Me To Your Scientist* game took over London’s Science Museum after dark and required players to gather and reinterpret information on exhibits in order to misinform a number of lurking “aliens”—our own performers who were visiting the museum to assess planet Earth’s threat level to the rest of the universe.

3. Your players are your marketing.

There’s no doubt that when designing physical games for museum spaces you need to think hard about the impact on other visitors. The timing and structure of the physical elements of our *Tate Trumps* game for London’s Tate Modern were precisely determined to ensure that players weren’t incentivized to run or disrupt other visitors. Several of our Southbank Centre *Tiny Games* were designed to be played in one’s head, or purely through conversation, to balance the impact of our more physically involved games.

But while it’s necessary to design carefully, it’s also crucial not to overlook the opportunities a public location offers. In a well-designed game, the players unwittingly become not just the marketing, but also the tutorial for your game. Other visitors see them playing and become curious about what they’re up to. Make sure to capitalize on this by considering how well your game “reads” from the outside. Will onlookers be able to understand what’s happening? Could you use some signage, badging, or stickers to help newcomers make a visual connection between the people already playing and the place they need to go to start playing? We’re big fans of hats and sashes—often cheap, usually high impact, always fun.

*Dreadnaught*, a game we produced in collaboration with artist Peg Spotov for the National Museum of Scotland, was a great expression of this idea. Players attempted to find game tokens and avoid mines, while wearing headpieces that completely obstructed their vision. They had to rely on teammates, who helped them navigate from the sidelines. Spotov’s magnificent headpieces meant the game drew huge crowds, some of whom simply enjoyed the game as a visual spectacle, but many of whom joined the queue for the next round.

4. Your partners are your insurance.

Games aren’t quite like any other medium. A good game has a little bit of invisible clockwork that makes sure that risks and rewards remain in interesting tension, that different strategies and play styles are all viable. But risks and rewards remain in interesting tension, that different strategies and play styles are all viable. It’s well worth finding experienced collaborators who can help introduce you to relevant games you might not know, who can help you find the right playful expression of your educational or entertainment goals, and who can make sure that a game that sounds great on paper actually works satisfyingly in practice. And whatever else, get playing yourself! We’re always happy to suggest good physical games to try, or local gaming nights you can join.

Games have been a part of human social life for thousands of years. We’ve lost track of that a little in the last century, with the rise of broadcast media and screen-based games. Now we’re just starting to chart the kinds of experiences, relationships, and learning we can trigger when we go back to that tradition of playing physical games in public. If you were looking for the ultimate venue in which to explore these experiences—a rich environment that brings people together to seek out new ideas and perspectives—it’s hard to imagine a better place than a science museum.

---

**Margaret Robertson** (Margaret@hideandseek.net) is managing director of *Hide&Seek* New York. Hide&Seek is a game design studio headquartered in London, which creates both physical and digital games.
I did not grow up as a gamer. Most of my younger colleagues will tell you they can beat me at anything with a controller. But I’ve been playing a lot of games over the past few years in my quest to learn how games people play in their free time can be leveraged for science learning. This is the focus of my work at the Educational Gaming Environments group (EdGE, edge.terc.edu) at TERC, a research-based organization in Cambridge, Massachusetts.

Of all the video games I’ve played, Portal (www.valvesoftware.com/games/portal.html) really caught my attention. The developers have scaffolded the gaming experience in a way that mirrors formal educational pedagogy (though it never feels that way to the player). The game is a series of test chambers, and players have to apply what they have learned in increasingly complex contexts to get from one chamber to the next.
Portal is one of the models we at EdGE examined when thinking of how to design games that are highly challenging, exciting, and also educationally substantive. EdGE is in the business of supporting and studying science, technology, engineering, and math (STEM) learning through gameplay. We design games with compelling graphics and storylines that engage players with science concepts, inquiry, and thinking. Our games are meant to be enjoyed in players’ free time.

Because we’re researchers as well as game designers, we are particularly interested in building assessments directly into games, allowing us to find out what and how people are learning as they play. Another major area of interest is how to build social communities within games to promote learning.

**GAMES AS TEACHING AND ASSESSMENT TOOLS**

As I played Portal, I realized that I was watching myself learning. I never exited a chamber by chance; I always knew exactly what I did to get there, and I could apply increasingly sophisticated game mechanics in very complex contexts. (“Game mechanics” is a term game designers use to describe how they enact the rules of the game, determine a player’s success and failure, and provide feedback to help the player advance.) As an educator, I realized that games could be not only great teaching tools, but also assessment tools.

My colleagues at EdGE and I, along with others in the field, asked ourselves: What if we created games where the game mechanics accurately mirror the laws of nature? Players would be able to learn about science through an activity that they found compelling, and we could measure their learning at the same time.

One of our current projects, a game series called Leveling Up, is a good example of how games can be used both to teach and to assess learning. The game mechanics for Leveling Up games are based on high school science content, such as forces and motion, structure of matter, and diversity and adaptation of living organisms. EdGE researchers are designing a set of game challenges to assess individual players’ science knowledge effectively and seamlessly within the game—without interrupting the gameplay. We do this by observing the strategies players develop over time and mapping them onto cognitive strategies related to science understandings. We are also working with a cohort of teachers to design classroom activities that link to what students are learning through the games.

One of the games in these series, Impulse!, is designed to model Newton’s laws of motion. It starts out with a simple structure similar to that of Angry Birds—players have to propel a ball into a goal. As players advance through the levels, they need to contend with gravitational forces, electrical forces, and other obstructions. We’re anticipating that students who play this game will be better predictors of physical laws when they encounter them in class.

In another Leveling Up game called Quantum Spectre, players use flat and curved mirrors, lenses, filters, beam-splitters, and other objects to direct one or more laser beams to targets while avoiding obstacles. Soon players will be able to create their own puzzles and share them with other players in the community.

**A COMMUNITY OF SCIENTIFIC INQUIRY**

Like Quantum Spectre, many of EdGE’s games will be part of a STEM gaming portal intended to foster a community where players engage with one another, create their own learning experiences, and actively participate in scientific inquiry. We’re working in social gaming environments to find out: How do you intentionally support a community of scientific inquiry within a game?

One successful example of community building occurred in our very first game, Martian Boneyards, launched in
May 2010 with support from the (U.S.) National Science Foundation (NSF). We chose a high-definition, massively multiplayer online (MMO) environment called Blue Mars (www.bluemars.com), which represented a terraformed Mars of the future. We designed an abandoned science center in the MMO and distributed all kinds of bones on the beautiful grounds surrounding the center. Three of us at EdGE played characters in this game—a team that supposedly discovered the bones while working to reopen the science center. We said we needed volunteers from the Blue Mars community to help us solve the mystery of what happened there.

Over four months, 66 core members of the Martian Boneyards player community used tools from the virtual science center and conducted their own research (on the web and in museums) on comparative anatomy to correctly identify the skeletons of a male and female human, Neanderthal, chimpanzee, and lemur. Working together, the players spun a tale of mystery, genetic engineering, passion, and murder, all based on the evidence we had put into the game. We did no teaching or content delivery. We laid out the design of the game, but players’ activity drove the game’s development and fed back into the game design in turn.

When the game ended, we held an awards ceremony to recognize the players’ efforts. The players attended enthusiastically, and even bought evening wear for their avatars! When the awards were announced, the strong sense of community was evident as they clapped for and hugged each other.

The top award winner was a woman with no scientific background who collected an incredible amount of data and information to solve the mystery. When we first asked her to share her work with the community, she replied, “Why would they want to see it? I don’t know anything about science.” But later, other players began to come to her seeking her advice. They started calling her “Doc,” and by the end of the game, she was leading the inquiry. When we asked her what drove her to do this for four months, she said, “It was the mystery. If I have to learn science to solve that mystery, I’ll learn science. I’m a gamer—I never give up.” Her words made us realize the value of designing games that leverage gamers’ identity and behaviors—their initiative, determination, persistence, and pride—to support science learning.

Our research showed that the core players—who were all avid gamers but mostly nonscientists—engaged in high levels of inquiry, including analysis and theory-building. Expert scientists who reviewed the players’ postings and discussions concluded that their self-initiated work was comparable to an introductory undergraduate group project. EdGE’s research into the players’ social interactions showed that sustained

We asked ourselves: What if we created games where the game mechanics accurately mirror the laws of nature? Players would be able to learn about science through an activity that they found compelling, and we could measure their learning at the same time.

![Quantum Spectre](Image courtesy EdGE@TERC)
scientific inquiry can be nurtured in an MMO game and that gamers’ relationships with characters in the game and other players may help facilitate inquiry.

After more than two decades as a science educator, I’m more excited now about science learning than ever. Research is showing us that people are learning in museums, through TV, on the internet, and more and more, in gaming environments. Ultimately, at EdGE, our goal is to measure, track, and further validate game-based learning, until we reach the point where the value of gaming as a tool for teaching science and assessing learning is evident.

Jodi Asbell-Clarke (Jodi_Asbell-Clarke@terc.edu) is director of the Educational Gaming Environments group (EdGE) at TERC, based in Cambridge, Massachusetts.

ASTC’s Board and staff wish to thank our Partners for their leadership and generosity. We are truly grateful for their visionary support.
BRING THESE EXCITING FULLDOME SHOWS TO YOUR PLANETARIUM!

Children love captivating characters and engaging storylines. Teachers love real science content and integration of science learning objectives. Fulldome planetarium shows from Morehead Planetarium and Science Center have it all! Choose a Morehead production to expand your field trip programming.

Magic Tree House children’s books are bestsellers worldwide, published in more than 30 countries and 29 languages. Now Jack and Annie, the lead characters of Magic Tree House®, bring their exciting adventures to your fulldome planetarium!

Join Jack and Annie on a fun-filled journey to discover the secrets of the Sun, the Moon, planets and space travel. This show aligns with information skills learning objectives for early elementary grades and is appropriate for ages 5-10.

Run Time: 30 minutes.

An original UNC Morehead Planetarium and Science Center production, written by Will Osborne, co-author of Space, the non-fiction companion and research guide to the Magic Tree House® book Midnight on the Moon.

Blast off — on a futuristic journey through our Solar System! Space traveler Jack Larson embarks on a mission to discover a new home for Earth’s humans, with the help of a smart young stowaway. This show aligns with national science curriculum objectives and is appropriate for ages 10 and older (a perfect choice for middle school groups).

Run Time: 27 minutes.

The material contained in this planetarium show is based on work supported by the National Aeronautics and Space Administration (NASA) under grant award number NNX09AL78G. Any opinions, findings and conclusions or recommendations expressed in this material are those of the author and do not necessarily reflect the views of NASA.

Meet Coyote, an amusing character adapted from American Indian oral traditions. Coyote has a razor-sharp wit, but he’s a little confused about lunar phases, eclipses and other things he sees in the sky. Together, Coyote and the audience discover how Earth, the Moon and the Sun travel through space. This show aligns with national science curriculum objectives and is appropriate for ages 5-11.

Run Time: 26 minutes.

Morehead Planetarium and Science Centers offers these original fulldome planetarium shows for lease through international distributor Sky-Skan. To review any show and receive more information, please contact Sky-Skan directly at sales@skyskan.com or at +1 603-880-8500.
Weather is ENLIGHTENING

Create interactive weather exhibits by leveraging Weather Underground’s dynamic weather feeds, meteorological expertise and climatology content.

For FREE weather modules, contact Ambar Muñoz at ambar@wunderground.com
Three ASTC members were among the 10 recipients of the 2012 National Medal for Museum and Library Service from the (U.S.) Institute of Museum and Library Services (IMLS): Pacific Science Center, Seattle; theBootheel Youth Museum, Malden, Missouri; and the Long Island Children’s Museum, Garden City, New York. The National Medal is the nation’s highest honor for museums and libraries.

The Exploratorium, San Francisco, recently received three (U.S.) National Science Foundation grants:

• $8 million for a Research + Practice Collaboratory
• $750,000 for a web-based resource for informal science education professionals
• $525,000 to create a learning environment emphasizing local sustainability.

The EcoTarium, Worcester, Massachusetts, has received $500,000 from the Hanover Foundation for its Third Century Plan, a master plan named for the institution’s 200th anniversary in 2025.

IMLS has announced 152 awards for Museums for America Program grants, including 26 to ASTC members:

• Academy of Natural Sciences of Drexel University, Philadelphia: $149,911 (matching amount: $150,335) to support Changing Attitudes Towards Autism Access
• Amazement Square, Lynchburg, Virginia: $132,944 (matching amount: $317,993) to implement a health-focused curriculum
• Anchorage Museum at Rasmuson Center, Alaska: $148,750 (matching amount: $1,692,768) for an exhibition that interprets Dena’ina Athabascan history and culture
• Buffalo Museum of Science, New York: $150,000 (matching amount: $885,610) to create a Motion Science Studio
• Chabot Space and Science Center, Oakland, California: $149,885 (matching amount: $335,602) to expand the Galaxy Explorers/Champions of Science program
• Children’s Discovery Museum of San Jose, California: $150,000 (matching amount: $359,505) to address food literacy
• Children’s Museum of Pittsburgh: $150,000 (matching amount: $391,892) for the MakeShop project
• Connecticut Science Center, Hartford: $99,750 (matching amount: $100,000) to conduct business and market research
• Creative Discovery Museum, Chattanooga, Tennessee: $148,727 (matching amount: 159,901) for the Youth Spark Initiative
• Discovery Center of Springfield, Missouri: $138,207 (matching amount: $138,379) for outreach to Head Start classrooms
• Fairbanks Museum and Planetarium, St. Johnsbury, Vermont: $150,000 (matching amount: $166,535) to develop the exhibition Nature, Climate, and Change: The Observer’s Gallery
• Field Museum of Natural History, Chicago: $125,814 (matching amount: $174,160) to develop the exhibition series Straight from the Field
• Lawrence Hall of Science, Berkeley, California: $149,330 (matching amount: $149,999) to meet the needs of children who are English Language Learners
• Long Island Children’s Museum, Garden City, New York: $150,000 (matching amount: $527,514) for a new exhibition, Broken? Fix It!
• Louisiana Children’s Museum, New Orleans: $148,000 (matching amount: $236,290) to support the Word Play literacy program
• Marbles Kids Museum, Raleigh, North Carolina: $100,288 (matching amount: $132,365) to implement a school readiness project
• Miami Science Museum, Florida: $149,955 (matching amount: $149,986) for an exhibit addressing the intellectual needs of adults
• Museum of the Earth at the Paleontological Research Institution, Ithaca, New York: $145,000 (matching amount: $145,658) for a new exhibition, Our Changing Earth Glaciers
• Museum of Science, Boston: $76,087 (matching amount: $77,558) to create an environment inclusive of people with disabilities
• North Carolina Museum of Natural Sciences, Raleigh: $129,697 (matching amount: $155,199) to improve its Earth Observation and Biodiversity Investigate Lab
• Perot Museum of Nature and Science, Dallas: $131,289 (matching amount: $138,209) to expand its volunteer program
• Rochester Museum and Science Center, New York: $149,733 (matching amount: $315,897) to develop an interactive exhibit component called the Inventor Center
• San Diego Natural History Museum, California: $141,829 (matching amount: $143,230) to create a website for the Herpetology Atlas of Peninsular California
• Science Museum of Minnesota, St. Paul: $150,000 (matching amount: $154,186) to build staff knowledge of state and national educational standards
• South Florida Science Museum, West Palm Beach: $148,050 (matching amount: $148,478) for science education for teachers and fourth graders
• Yale Peabody Museum of Natural History, New Haven, Connecticut: $148,050 (matching amount: $148,344) to provide professional development for teachers in ecology and environmental science.
Whether it’s the world’s biggest wardrobe malfunction or MacGyver meets Survivor, Ainissa Ramirez knows that generating interest in science requires a hook. A professor at Yale University, Ramirez prefers the title “science evangelist”—in her words, a person who “takes the call” to ignite curiosity in kids of all ages. She spoke with Dimensions about the importance of science, technology, engineering, and math (STEM) education—the topic of her TED Talk last year (blog.ted.com/2012/03/02/a-sputnik-moment-for-stem-education-ainissa-ramirez-at-ted2012)—and how to put science in unexpected places.

**Tell me about your evangelistic efforts.**
Science Saturdays was a lecture series for kids. The lectures averaged about 175 people, and when [the topic was] dinosaurs, it was 300 and standing room only. I wanted to reach more people, so I started this video series called *Material Marvels* (www.materialmarvels.com) and [another] series called *Science Xplained*. One video is on Napoleon’s buttons (video.yale.edu/video/science-xplained-napoleons-buttons), which supposedly turned to dust during his campaign into Russia because tin, the main component, disintegrates at very low temperatures. The myth is that the army experienced the world’s worst wardrobe malfunction. Tin is very important today because it’s a main component of solder, which is in all electronics. I try to hook people and put things in a way that’s interesting and fun.

**Why is it important to hook kids into learning about science?**
I’m writing a book for TED Books called *Flip this Class* on that topic. We want to make the next generation the builders of the future, not just the consumers. As a scientist, the best pathway that I know is STEM. The skills you need in STEM—being curious, being patient, relying on your imagination and making friends with failure—those are things we don’t get to exercise when we’re beholden to taking tests.

**How can readers of Dimensions help in this charge?**
The school system is not going to change overnight. I believe that it’s STEM outside of the schools—I call it SOS—that’s going to keep children engaged. Museums and science centers can keep science in the conversation.

**A Public Broadcasting Service (PBS) show inspired you to follow a scientific career path. What could inspire young people today to take a similar tack?**
There weren’t any scientists in my neighborhood. *3-2-1 Contact* shot this flare in the air that said “science,” and I saw it and said, “I’m going to follow that.” We need to promote shows that are science-related. There’s a scene in *Apollo 13* where the CO2 scrubbers were failing and they had to make one using a few items, like a sock, bungee cord, and duct tape. We need a show like that. It’s *MacGyver* meets *Survivor*. If we’re in the reality TV phase of television, let’s put science in reality TV.

Think about putting exhibits in unusual places—in McDonald’s, in the mall. Think of places where people are stuck—waiting rooms, the Department of Motor Vehicles, bars—put some explainers there. You’re going to hit kids you’ve never hit before, because they never thought about going to a science museum. If we really want to get new eyeballs to see science, then we have to go to where they are.

For a podcast and full transcript of this interview, visit www.astc.org/blog/category/astc-dimensions/q-and-a/.
EXHIBITIONS

DinosaurS IN MOTION  TITANIC THE EXHIBITION  SEX ED: THE EXHIBITION  ENGINEERING EARTH  SACRED TEXTS

CONSULTING

ARTSCIENCE MUSEUM, SINGAPORE  MOB ATTRACTION, LAS VEGAS  GEORGIA AQUARIUM, ATLANTA

VENUES

IMAGINE EXHIBITIONS GALLERY, LAS VEGAS

TO LEARN MORE ABOUT OUR SERVICES, CONTACT...

DEBBIE DONOHUE
TEL +1 404 808 7578
EMAIL ddonohue@imagineexhibitions.com
FACEBOOK facebook.com/ImagineExhibitions
WEBSITE www.ImagineExhibitions.com
If you’re looking to maximize your professional development dollars, look no further than ASTC’s 2013 Annual Conference, to be held in Albuquerque, New Mexico, October 19–22.

Three host institutions—Explora, the National Museum of Nuclear Science and History, and the New Mexico Museum of Natural History and Science—are teaming up on what promises to be a powerful, valuable, and unforgettable experience.

This year, Museum Open House Day, Big Screen Day, and Digital Planetarium Demonstrations have been moved to Tuesday, along with a fantastic public Science in the Park festival...you won’t want to miss this!

Registration opens in mid-March!