INFORMING THE CITIZENRY AND STUDENTS THROUGH PUBLIC OUTREACH PROGRAMS MAKING USE OF SCIENCE AND THE ARTS

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Abstract

The medium is the arts; the message is the joys of science. The performing arts are being used to make science and technology accessible, relevant, and exciting in ways that provide both scientific content and significant artistic values. Since many societal issues - medicine, global warming, the environment and energy - have a major scientific component, it is essential for public policy making in a democracy that citizens be informed and engaged, not least in the ethical considerations that often drive policy. The performance series *Science and the Arts* has been developed and tested at the Graduate Center of the City University of New York (CUNY) in mid-Manhattan for more than five years, see http://web.gc.cuny.edu/sciart/. The National Science Foundation (NSF) recently acknowledged our accomplishments in science outreach by awarding the Graduate Center a major grant in the field of science and the arts. The purpose of the grant is focused on implementing the development of science outreach programs at colleges and universities throughout the United States. Our extensive science and the arts outreach projects will be described, as well as the author's role in producing two musical versions of a play, *Einstein's Dreams*, based on the novel by Alan Lightman, in Lisbon, Portugal and Philadelphia, Pennsylvania. Increasingly, science outreach through the arts is becoming an international venture.

Keywords: Science, Art, Theater, Outreach, Public Understanding of Science

1. Introduction: Major New Initiatives

In May 2005 the Graduate Center was awarded a three-year grant from the National Science Foundation entitled "Science as Performance: A Proactive Strategy to Communicate and Educate Through Theater, Music and Dance," with Dr. Brian Schwartz as Principal Investigator (P.I.). The grant is focused on implementing the development of science outreach programs inspired by the *Copenhagen Symposium* and the *Einstein Centennial* at colleges and universities across the country. [1] In effect, the P.I. will guide and assist institutions of higher education in developing similar outreach programs at the intersection of science and the arts in ways that are meaningful and appropriate to their own communities.

As an example, as part of the NSF grant, the P.I. visited Atlanta, GA, and met in a joint meeting with faculty and students from Science, Literature and Performing Arts Departments of Agnes Scott College, Clark-Atlanta University, Emory University, the Fernbank Science Center, Georgia Tech, Georgia Perimeter College and Morehouse College; as well as literary and performing artists from organizations throughout the city. The more than 25 participants at the meeting, some of whom had been working on individual projects in disciplinary isolation, enthusiastically embraced the idea of creating partnerships that crossed traditional boundaries to bring innovative and diverse science-centered outreach programs to their students, citizens and communities through the medium of the arts. For this purpose the P.I. also has visited Middlebury College in Vermont and the University of Wisconsin, Madison and will pay similar visits to the University of California at San Diego during this first year of the NSF grant and to four additional institutions in each of the two subsequent years of the NSF grant.

After the initial meetings, the P.I. and his staff work with committed individuals and institutions to provide examples of excellence in programming; and share databases of plays, performers and resources in the field. In each of the three years of the grant, the P.I. will invite key individuals from the institutions visited that year to the Graduate Center for a weekend seminar of special programs during which they will interact with each other and share plans for developing science outreach programs of their own. In the middle of its third year, the NSF project will hold an international conference on the subject of science and the arts with a focus on the performing arts. In effect, this grant will turn our Graduate Center series into a model to be disseminated and replicated nationally and internationally.

Figure 1. The Science and the Arts Marquee: A Symbol of the Outreach Efforts

2. Science & the Arts Series

In 2000 the author developed and began producing the ongoing Science & the Arts Series at the Graduate Center. Our innovative - and often cutting-edge - experiments in presenting science programs through the medium of the performing arts, visual arts and literature have shown that public outreach programs can result in high levels of success in scientific content, while providing excellence in artistic programming. Each semester at least five - usually more - major public programs have been presented at the interface between science and theater, art, music and dance with considerable response from the audience and publicity in the national press. [2] The most recent productions are annotated further on in this paper. During the coming academic year, at least four of the programs will be related to Benjamin Franklin and his richly diverse scientific and technological interests in honor of the tercentenary of the birth of America's first scientist. Following are examples of the types of programs which are being developed to be offered by this Series:

Franklin's Glass Armonica - "Of all my inventions, the glass armonica has given me the greatest personal satisfaction," Benjamin Franklin wrote. Imagine a wine glass and the sound made by circularly stroking a wet finger on its rim. Franklin designed a sophisticated instrument - the armonica - based on this idea. Mozart and Beethoven composed for the armonica and it has caught the attention of contemporary composers, as well. A program is being developed that includes the history of Franklin's invention, followed by a performance by a professional armonica player. Composer Peter Kirn will discuss the physics behind the armonica's sound and how he has re-imagined the instrument in virtual, digital space, as a physically-modeled software instrument and 3D visualization.

Stealing God's Thunder: Benjamin Franklin's Lightning Rod and the Invention of America - A talk by Pulitzer Prize finalist Philip Dray. His most recent book, "Stealing God's Thunder," is a richly detailed biography of Benjamin Franklin viewed through the lens of his scientific inquiry and its ramifications for American democracy. The book uses the evolution of Franklin's scientific curiosity and empirical thinking as a metaphor for America's struggle to establish its

fundamental values. Dray will discuss how Franklin unlocked one of the greatest natural mysteries of his day, the seemingly unknowable powers of electricity and lightning.

Theatre of Science – A theatrical entertainment featuring British science writer Simon Singh and psychologist (and former magician) Richard Wiseman, who will electrify the stage of the Arclight Theater in Manhattan. The finale of their science-as-performance show will produce a million volt bolt of lightning as one of the performer enters a coffin-shaped cage, absorbs the full force of the strikes, and survives to explain the science behind the phenomenon.

A Staged Reading – A reading by Break-A-Leg Productions of a play about the brilliant, but often neglected, Serbian born physicist, inventor and electrical engineer, Nikola Tesla (1856 – 1943). Tesla, among many other scientific interests, shared Ben Franklin's fascination with electricity, developed the Tesla coil, and worked with Thomas Edison and, later, George Westinghouse in America. He was the holder of scores of patents in a range of fields including electricity, energy, radio, wireless, electromagnetism and seismology. A genius and an eccentric who was far ahead of his time concerning space travel, Tesla envisioned the possibility of life on Mars, talked to pigeons, and died destitute in New York City. The corner of Avenue of the Americas and 40th Street, in Bryant Park has been memorialized by the City as Nikola Tesla Corner.

Arcs & Sparks – A program of scientific demonstrations in consultation with the Franklin Institute of Philadelphia, PA. The Institute is presenting a year-long series of events to celebrate the Franklin Tercentenary. The Arcs & Sparks program demonstrates the power of electricity in a live, interactive, high voltage show in which the spirit of Ben Franklin comes alive as lightning bolts and electrical fire dance on the stage. Some of Franklin's most dramatic experiments are recreated using 18th century equipment. This highly charged event will take place on the stage of the Graduate Center for New Yorkers of all ages.

3. Novel Science and the Arts Outreach

3.1 Street Fair Science

We are particularly interested in bringing science to children and adults at unusual, unexpected venues. As part of this commitment we are planning to test the concept of Street Fair Science in June 2006. If our experiment is a success it will be replicated in future years. On a sunny Saturday and Sunday in June, two of the ordinary New York street fairs that are scheduled throughout the neighborhoods of the City will include within their blocks and booths an unusual event - the Street Fair Science. In 20 booths, over two days, Street Fair Science will bring the excitement and energy of science to children, families and adults as they stroll through what would otherwise be a typical New York street fair.
Why does popcorn pop and cotton candy spin?
Savor hands-on experiments!
Marvel at a science-educator-magicians demonstrations!
Have your photo taken with an Albert Einstein look-alike!
Behold Mr. Bubble demonstrating the science of bubbles large enough to step inside!
Science museums in the City will cooperate by bringing demonstrations and encouraging little hands to conduct experiments. Vendors will sell science toys and books. Gymnasts, dancers and martial artists will demonstrate the scientific principles behind motion and forces. Jugglers will playfully demonstrate timing, angular momentum and the laws of gravity. If people do not come to science, science will go to the people!

3.2 The New York Science + Art Festival

New York City is a capital both of science and the arts. This will be abundantly apparent this fall from November 9 to 12, 2006 when the Graduate Center of the City University of New York (CUNY) collaborates with the Society for Literature, Science and Art, the Center for Inquiry, the Dactyl Foundation, *Skeptical Inquirer* magazine and many other organizations and performers in presenting four days of special science and arts events at venues throughout the City. In partnership with the 2006 New York Science + Art Festival, [3] we will help organize events for this city-wide festival. Dozens of scientific and theatrical performances and lectures are in the process of being planned. Museums, cafes, universities and galleries will host family-centered science productions presented through the medium of the performing and visual arts. Again, we bring science to the people!

3.3 Science & the Arts in the Public Schools

We are considering the use of science and arts programming to introduce young people from junior high school age and older - including underrepresented minority students and girls - to science in new and creative ways that will encourage scientific literacy and lead increasing numbers of them to enjoy and understand scientific endeavors. For example, a number of our Ben Franklin-related presentations – and other events - will be disseminated, at no cost, to New York City school students either through arranged class visits to the Graduate Center, or by means of special presentations at high school auditoriums. We currently are consulting with New York City high school teachers and administrators to consider the possibility of designing appropriate science and the arts outreach programs that will complement and enhance existing school curricula and standards.

3.4 Theatrical Productions of *Einstein's Dreams*

For the past three years, the authors have worked to bring the extraordinary novel, *Einstein's Dreams*, by physicist and writer Alan Lightman, to the stage as a musical. The book imagines what the great man might have dreamt about time and space in 1905, his *annus mirabilis*, when he was preparing his three seminal papers for publication. The authors commissioned Broadway composers, lyricists and writers and worked with them to develop two separate productions of *Einstein's Dreams.* The first version was presented five times as concert readings at a variety of New York City venues, including the Graduate Center, culminating in a presentation at the American Museum of Natural History in association with the Museum's centenary celebration of Einstein's 1905 publications. That version went on to a full, professional production by the Teatro da Trindade in Lisbon, Portugal [4] and enjoyed a hugely successful 4-month run. The second version of *Einstein's Dreams* with which the authors are associated is being written by the acclaimed playwright Albert Innaurato in cooperation with the Prince Music Theater in Philadelphia, Pennsylvania. It is anticipated that this version will be workshopped at the Prince in 2006.

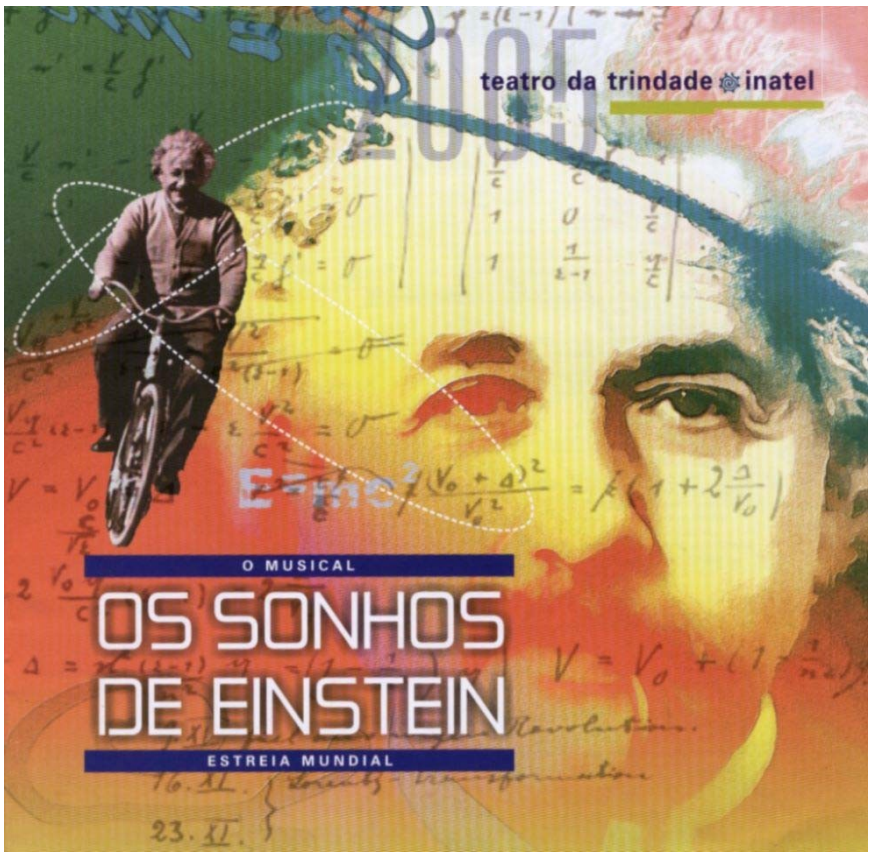

Figure 2. Program for the Portuguese Version of *Einstein's Dreams* at Teatro da Trindade, Lisbon

4. Recent Science & the Arts Series Presentations

4.1 Spring 2005 - Albert Einstein Centenary Series

In 2005 the Series celebrated the 100th anniversary of Albert Einstein's *annus mirabilis* in 1905 (when 3 seminal papers by Einstein were published) with a group of public lectures, discussions and dramatic events that focused on the themes of Einstein's work and life. Einstein events included:

Einstein Simplified: Cartoons on Science - Illustrated lecture by Sidney Harris, America's foremost science cartoonist**,** author of *Einstein Simplified* (Rutgers University Press).
Einstein and Freud: A Discourse Concerning Two New Sciences - Talk by Richard Panek, author of *The Invisible Century*: *Einstein, Freud and the Search for Hidden Variables* (Viking Books).
The Physics of Star Trek – Talk by Lawrence M. Krauss, Chair, Dept. of Physics, Case Western Reserve University before an audience of 600 students at Stuyvesant High School in New York. [5]
Two Plays about Einstein - *Mass*, by playwright Lauren Gunderson; performed by Break A Leg Productions, *The Day Einstein Died*, by playwright J. B. Edwards; performed by Third Avenue Productions.
Two of Einstein's Associates Reminisce - Frederick Seitz, former president of the Rockefeller University, former president of the National Academy of Sciences and colleague of Einstein at Princeton, and William T. Golden, architect of U.S. science policy, the National Science Foundation and former member of the President's Science Advisory Committee.
How to Think Like Einstein – Talk by Joe L. Kincheloe, Professor of Education, The Graduate Center, Co-author of *The Stigma of Genius: Einstein, Consciousness, and Education* (Peter Lang Publishing).
Einstein, Surveillance and Social Activism – Talk by Fred Jerome, author of *The Einstein File: J. Edgar Hoover's Secret War Against the World's Most Famous Scientist* (St. Martin's Press) and *Einstein On Race And Racism* (Rutgers University Press).
Einstein's Vision of Space, Time and Parallel Universes – Talk by Michio Kaku, Semat Professor of Theoretical Physics, City College of New York.
The response to the Einstein Centennial programs was beyond all expectations. Each event drew capacity crowds who sought to participate, learn and interact with the varied programming.

4.2 Fall 2005 - Science & the Arts Series

Crocheting the Hyperbolic Plane – Mathematicians Daina Taimina and David Henderson explained the concept of the hyperbolic plane through the use of crocheted models.
Flyer – A reading by Break-A-Leg Productions. This play by Kate Aspengren leapfrogged through time to explore the question of whether women should be astronauts..
Voodoo Science in the Age of Intelligent Design – Talk by Robert L. Park, Professor of Physics, University of Maryland.
Visual Art & the Brain – A day-long conference on the science of vision, our emotional response to art, and contemporary art that addresses science. [6]
Big Bang: The Origins of the Universe – A talk by Simon Singh, British physicist and best-selling author.
Perpetual Motion: Revolutions in 17th Century Science and Music – Award winning author Dava Sobel and the early music ensemble Galileo's Daughters, weave stories of science history with performances of the music of the period.

4.3 Spring 2006 - Science & the Arts Series

Science Valentine – A science vaudeville evening featuring Lynda Williams, the "Physics Chanteuse" and Bob Friedhoffer, science magician and educator.
Soft Science – Experimental films on science created by scientists and artists.
An Experiment with an Air Pump – A play by Shelagh Stephenson about ethical choices in the pursuit of scientific progress with a reading by Break-A-Leg Productions.
Robot Dance Competition – RoboCup Junior is an international design competition organized by elementary through high school New York City area teams.
The Violin: De-Coding Perfection – Talk by Toby Faber, author of "Stradivari's Genius" and the celebrated contemporary instrument maker, Sam Zygmuntowicz, with a demonstration.

Big Bang: Premiere of a New Concert Theater Work – Music inspired by astrophysics with a live performance by composer Patrick Grant and narration by Dr. Charles Liu, astronomer.
"Intelligent Design" Under the Microscope – An evening of presentations on this controversial movement co-organized with the Center for Inquiry.

5. Conclusion

Public programming at the intersection of science and the performing and visual arts has become a world-wide phenomenon – one in which the Graduate Center of the City University of New York has played, and continues to play, a leadership role. The roots of this movement lie in the commitment of scientists to educate and inform the general public, and particularly young people, about the excitement and importance of science – the pure joy of doing science. For artists in all disciplines the movement has provided a rich, new landscape of themes, colors, sounds and language to explore. We anticipate ongoing rewards for children, students, citizens and societies as this phenomenon - science and the arts - strengthens, expands, spreads and transforms our way of seeing and understanding.

6. References

[1] See http://web.gc.cuny.edu/sciart/copenhagen/copenhagen.html
[2] See http://web.gc.cuny.edu/sciart/archive.html
[3] See http://www.scienceartfestival.com/
[4] See http://teatrotrindade.inatel.pt/html/Pg_einstein.htm
[5] Clyde Haberman, "*Feeling Good About Physics, Like Einstein,*" *The New York Times*, March 15, 2005
[6] Catherine Zandonella, "*Probing the Picasso Lobe: What Scientists are Learning; What Artists Know,*" Update, New York Academy of Sciences Magazine, March/April, 2006.

Supported in part by the National Science Foundation, NSF PHYS-0431660 and the Richard Lounsbery Foundation