

## **A Bridges Center for Mathematical Connections in Art and Science**

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### **Abstract**

This presentation is a proposal for the future “Bridges Center” which will host series of Bridges related events. It could potentially become a model for multi-discipline work of collaborations between mathematics and its connection to arts, science, and architecture. This multipurpose center will function as (a) an art exhibition space, (b) mathematical art workshop space, and (c) lecture, theater/music, performance space. To present this idea, we have visualized this center into a virtual center that user can interact and navigate within this environment.

### **Introduction**

The international annual conference of Bridges: Mathematical Connections in Art, Music, and Science was founded in 1998 at a private liberal arts college in Kansas, Southwestern College. It is an annual conference, which has provided a remarkable multi-disciplinary model of collaboration between mathematics and its connection to arts, science, architecture, culture, music and theater. The genuine efforts of many founding members of this organization provided an inspirational model throughout these years that has shaped the Bridges organization into one of the largest interdisciplinary conferences in the world. With their leadership and as an independent educational and scientific non-profit organization, Bridges conference has traveled across North America, Europe, and Asia. Each year, the conference hosts series of events including formal paper presentations, a display of mathematical visual art exhibition, hands-on workshop sessions with scholars in their respective fields, mathematically influenced musical, theater, poetry event, and a movie festival. In every Bridges public event, a dedicated family day opens its door to the public and families across the community. Kids and adults of all ages from the community get the firsthand experience of the art exhibition as well as the synthesis of math, art and science through workshops, games, short movies, and other activities.

Today, centers such as the Museum of Mathematics (MOMATH) in New York and the Baltimore Museum of Industry in Baltimore, which hosts varieties of events throughout the year that engages users, stimulate inquiry through mathematics and technology have been immensely successful in attracting students of all ages and their families. The proposed Bridges Center is a collaboration hub for mathematicians, scientists, educators, scholars, and artists from both inside and outside academia to develop innovative educational tools, such as software utilities, movies, textbooks, and other types of productions, and disseminate them among colleges and university, organizations, and government agencies. This center will provide a platform for developing mathematical art ideas through presentations of workshops for K-12 students and their families living in the Baltimore Metropolitan area. The

relationship between scholars and students will allow the center to continuously host mathematical art exhibitions, and also attract companies and resources in the Baltimore/Washington Metropolitan area to participate in this interdisciplinary collaboration. Here are some general ideas of how this proposed center will be used,

1. The center will be located at Baltimore Metropolitan area. Baltimore has a remarkable and reasonable property value which makes the center affordable. It is also conveniently located in the eastern corridor of the United States with several nearby airports including Baltimore Washington Thurgood Marshall Airport. Other transportation including buses and trains are also accessible to and from New York, Philadelphia, Washington D.C. and Virginia.
2. The proposed center will be a multipurpose space appropriate for 300 participants, which will include an area that includes a large room that can be used for (a) art exhibition/gallery, (b) lecture/theater/movie, and (c) K-12 workshops. This space will be designed for various other external activities as well.
3. The center will partner with local, regional and national academic, non-profit and government institutions to facilitate and develop programs and initiatives throughout the year.
4. The Bridges Center will also work with the annual Bridges conference to create programs and work with the mathematical artists from the conference to host and exhibit the art exhibition and family day workshops. The Bridges organizers and all other supporting members will collaborate in this initiative.

### The Origin and History

On January 22-26, 2007, organizers George Hart (Stony Brook University), Reza Sarhangi (Towson University) and Gerda De Vries (University of Alberta) proposed a workshop titled “Innovations in Mathematics Education via the Arts” at the Banff International Research Station for Mathematical Innovation and Discovery institute, Canada. A group of mathematicians and art educators was invited to discuss and brainstorm this promising areas and techniques of incorporating math education via the arts. In those five days, the group identified many promising areas of goals and possible outcomes. This intense intellectually energizing workshop was the foundation and a beginning of new ideas in the enhancement of mathematical education through art and science, which is now proposed as the “Bridges Center”.



**Figure 1:** Mathematicians and art educators participating in 5-day workshop “Innovations in Mathematics Education via the Arts” at the Banff International Research Station for Mathematical Innovation and Discovery institute on January 22-26, 2007.

During this workshop two promising ideas were developed:

1. Mini Bridges to Mini Van – a mobile version of Bridges Conference that can carry good sets of various math and art related workshops. It will be able to transport and carry different types of tessellation blocks, tools for solids constructions, tools for geometric constructions for the arts, manipulative sets and instruments for math and music workshops. It is also capable of carrying two-dimensional artworks and three-dimensional sculptures with different sizes from one place to another.
2. Bridges Center – a permanent Bridges center for collaboration of mathematicians, scientists, educators, scholars and artists to develop innovative artistic educational tools, software, movies, textbooks and other types of production that can be disseminated in colleges and universities and local and regional communities. The vision also included other activities such as public lectures, concerts, workshops and art exhibitions.

After completing the final report that originated from this workshop, Reza Sarhangi submitted the proposal of building the center to the Fisher College of Science and Mathematics at the Towson University. While the proposal was unable to gain interest from Towson University, he began to work with other local institutions and organizations for space and location.

The idea of a permanent “Bridges Center For Mathematical Connections in Art And Science” began to gain momentum after the Bridges Baltimore 2015 at the University of Baltimore, Maryland USA, which was organized by Sujan Shrestha.

### **A Virtual Bridges Center**

This part of the paper is presented as a proposal of a future Bridges Center as a scientific visualization. Visualizing the Bridges Center will provide a platform for discussion, which will engage the larger community in the Bridges organization, its members and community. The visualization prototype presented here is a three-dimensional conceptual architecture that has the potential of someday becoming a physical space. The virtual center is developed using three-dimensional modeling and electronic video game software.

This proposed center will be approximately 7200 square feet of total space. It will include a kitchen and bathrooms. The middle part of the center will open to a large space that can be transformed into (a) an art exhibition space, (b) mathematical art workshop space, and (c) lecture, theater/music/movie space. The building will also house a large storage space for the artworks and facilities towards the back with a loading dock.

### **A Prototype**

A prototype is a preliminary three-dimensional interactive visualization of a virtual Bridges Center. In this prototype, user is able to interact with artworks and read through the text. While this visualization serves a placeholder for the proposed center, we plan to use this visualization as a key documentation to develop a physical and permanent Bridges Center in the future. Ultimately, it will provide a space for discussion and collaboration among all stakeholders.

## The Future

The Bridges Center has the potential of becoming a remarkable model of an educational umbrella, which could possibly provide support for future development and innovation in STEAM education. The outlines listed below for these upcoming initiatives will also be included in the BridgesMathArt.org:

1. Develop fundraising programs that can be used for the physical construction of the Bridges center
2. Work with private donors and sponsors to establish new programs
3. Write and work with grant funding local and federal agencies

## Conclusion

Advances in new technology in teaching and learning in the areas of mathematics, arts and science, should be welcomed in the classroom of the 21<sup>st</sup> century. It is profoundly important to develop innovative ideas for mathematics and science education via the arts and technology. This is a broad field with many creative practitioners working in diverse media, including painting and sculpture, movies and theater, computer images and software developing, origami and quilts, music, etc. Experience shows that students and the public are receptive to mathematical and scientific ideas when presented in the context of a fine art display or a hands-on art activity. Many individual mathematics educators have developed programs that use art as a medium to engage students in mathematical thought and problem solving. By bringing together a core group of mathematical scientists, artists, and scholars with an interest in education and the arts, we expect to create this new collaboration leading to “A Bridges Center for Mathematical Connections in Art and Science”.

## References

- [1] G. Hart et al. 2010. “Forming a Museum of Mathematics”, In Science Exhibition; Communication and Evaluation, (A. Filippopoliti, ed.), ISBN 978-0-9561943-8-1.
- [2] C. Lawrence. 2013. “Adding It All Up: Building the National Museum of Mathematics”, Proceedings of Bridges 2013: Mathematics, Music, Art, Architecture, Culture.



**Figure 2:** *Three-dimensional renderings of the virtual Bridges Center.*