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STEAM LEARNING – COLLABORATIVE PROBLEM-SOLVING – CREATIVITIES – STARTUP THINKING – HANDS-ON & DIGITAL FABRICATION

Experience Workshop-Finland's GeoGebra Arts & STEAM Playground

WORKSHOP & SEMINAR @ Westfield State University

27 March, 2019. Hosted by Christine von Renesse

GeoGebra

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Contact: Dr. Kristof Fenyvesi (University of Jyväskylä-Finland), e-mail: info@experienceworkshop.org
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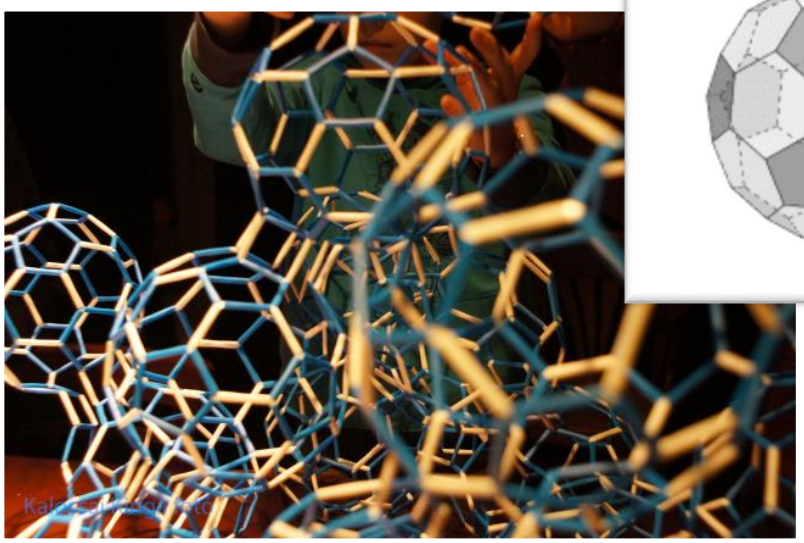
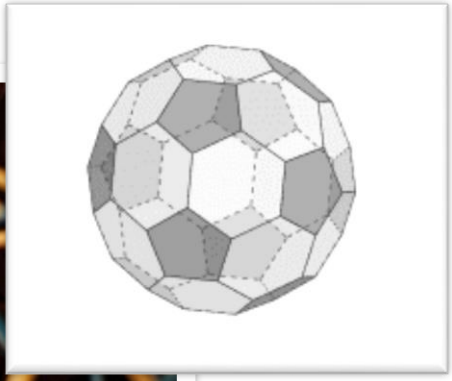
GEOGEBRA DESIGN LAB & FREESTYLE BODY BUILDING: MOLECULAR FOOTBALL, NANO-BASKETBALL, AND MORE with Experience Workshop's 4Dframe and Lux Blox

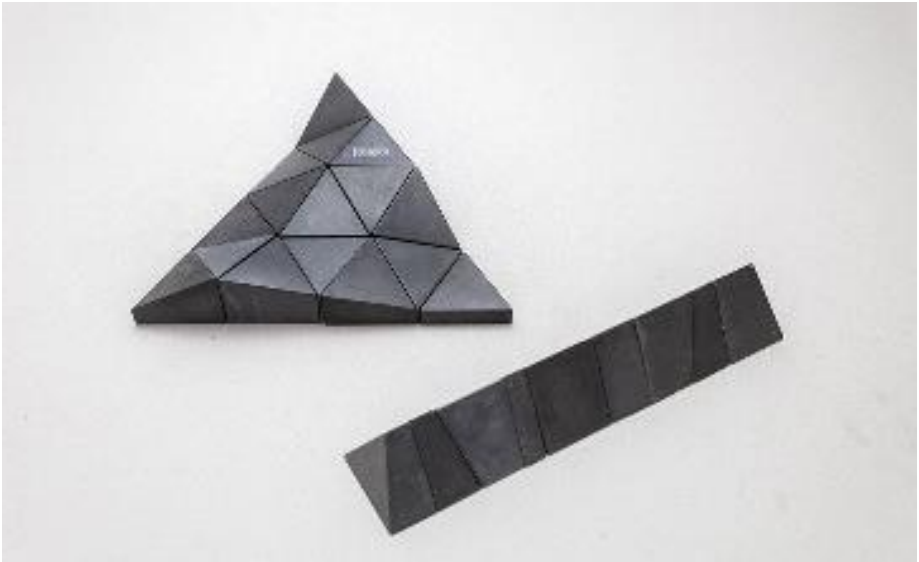
GeoGebra





Science & Art fun and games with Experience Workshop's 4Dframe and Lux buckyballs, nanotubes & crazy structures, all supported by GeoGebra apps.

Discover the fun of **Logideez**! Unleash your imagination while challenging your mind with a unique puzzle made of concrete or wood. Find the place for each prism in the **LOGIFACES'** equilateral triangle



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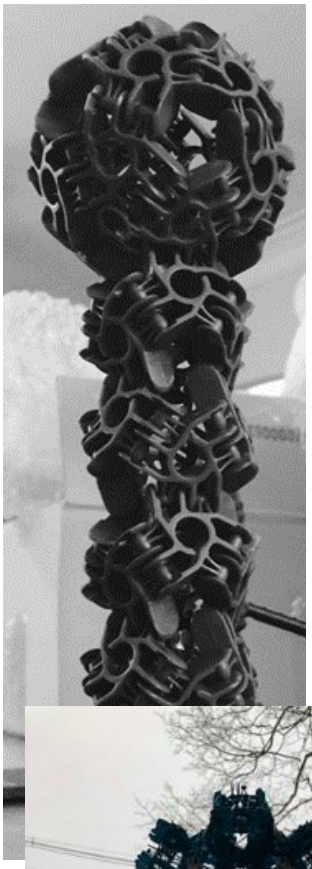
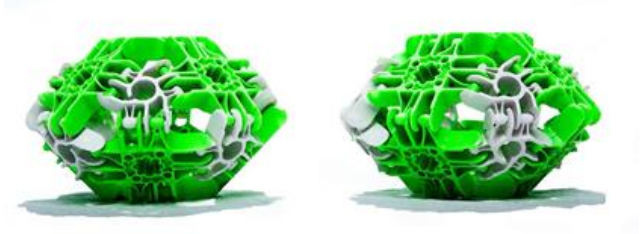
MEET THE CREATOR: Mike Acerra (Lux Blox)



Lux employs the power of what the designer Peter Jon Pearce calls MIX/MAX or minimum inventory/ maximum diversity. The chiral hinged connections enable the construction of cage and skin structures (monocoque construction) in which the tension of the material is exploited to create strong frameworks and lattices which can be organized into minimal surface structures that model nature from molecules to cell structure to plant and animal morphology and mechanics.

LUX can model Platonic, Archimedean, and Johnson Solids, periodic minimal surfaces such as Schwartz P Surfaces and gyroids, prismatoids, and all forms of carbon nanotubes and Fullernes, including nanobuds, and graphene lattices in both chiral and zigzag patterns.



Two Johnson solids, the gyro-bicupola, left, and the bicupola, right.

LUX can model virus structures and the morphology of protists, and even the internal networks in Radiolari, in which progressive polyhedral shell layers are connected by tubular radial spines.

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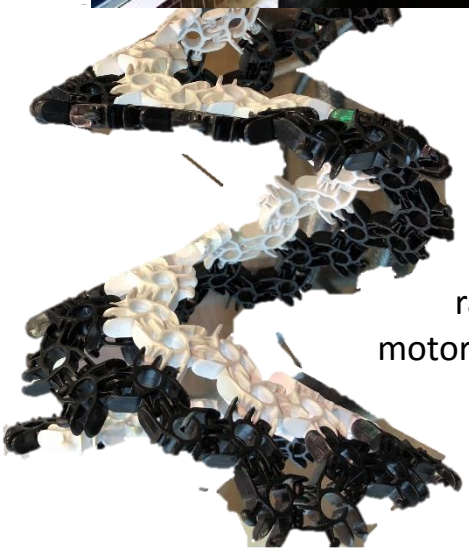

Recently LUX has modeled the helicoidal Terasaki ramp structure, the newly discovered transit for motor proteins between the concentric layers of the endoplasmic reticulum.

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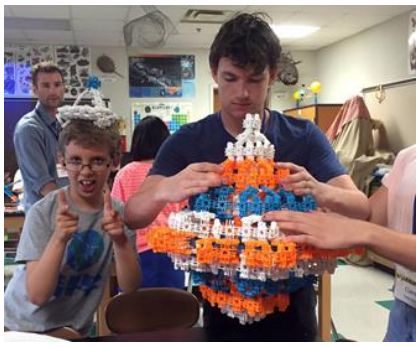
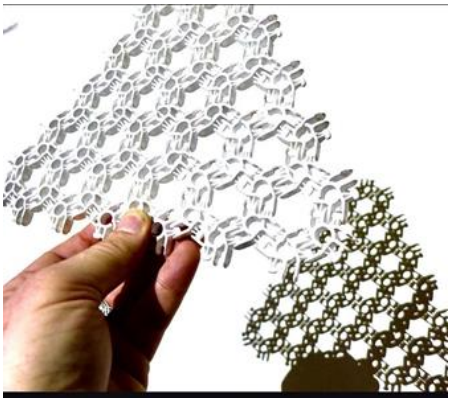
Lux models elaborate linkage systems like Sarrus linkages and other four bar linkages found in organisms from arthropods to mammals.



Lux can model the polymorphism of membranes associated with lipid structures. Lux creates membranes that can create spheres (micelles), pairs of layers that face one another (lamellar phase- lipid bilayer), a tubular arrangement (hexagonal), and various cubic phases.



Mike Acerra is the inventor of Lux. He created Lux with his wife, Heather, to bring the natural world to children as a hands-on creative learning experience.

SEMINAR: Rethinking Creativities for Mathematics Learning: Multi- and Transdisciplinary Approaches for Schools and Beyond

- Prof. Zsolt Lavicza, Experience Workshop, GeoGebra, Linz School of Education, Johannes Kepler University, Austria
- Dr. Kristóf Fenyvesi, Experience Workshop, University of Jyväskylä-Finland, Bridges Organization, International Symmetry Association
- Diego Lieban, Experience Workshop, GeoGebra, Linz School of Education, Johannes Kepler University, Austria
- Mike Acerra, Lux Labs

There is a growing emphasis for encouraging creative thinking in mathematics education and needs to develop connections of mathematics with other subjects. Activities focusing on the creative process, rather than concentrating on achieving only results for posed problems, are being designed and implemented by innovative groups around the world. Often involving Arts, in a broader sense of design and creation, can be good a starting point for students to find their own interests and follow their own way of learning (Burnard et al., 2016). Such creative activities often involve the development of collaborative problem-solving skills utilising students' strengths in different areas that adds up at the group level (English et al., 2008). Furthermore, such activity designs and the opportunities offered by innovative learning environments (ILE) and the availability of digital technologies inevitably afford new multi- and transdisciplinary approaches for education. In this seminar we will discuss ideas and examples for mathematics education involving STEM to STE-A-M (by the inclusion of Arts) transitions (Fenyvesi, 2016). Examples will include STEAM research with the Experience Workshop Movement; studies related to GeoGebra and it new developments such as Augmented Reality, 3D Printing and mobile experiments; developing mathematical skills through robotics and connecting digital and physical worlds with 4D Frame, Lux Blox, Logifaces and other tools; STIMEY and other projects from the Innovative Learning Environments Research Group in Finland, and possibilities to detect and nurture creative thinking processes from Big Data. An overview of such studies could offer new insights into developments of mathematical creativities, novel teaching approaches, and opportunities for further collaboration in these areas.

References

Burnard, P., Ross, V., Dragovic, T., Powell, K., Minors, H., Mackinlay, E. (Eds) **(2017)** '*Building Interdisciplinary and Intercultural Bridges: Where Practice Meets Research and Theory*'.

English, L., Lesh, R. A., & Fennewald, T. (2008). Future Directions and Perspectives for Problem Solving Research and Curriculum Development. Presented at the 11th International Congress on Mathematical Education.

Fenyvesi, K. (2016) Bridges: a World Community for Mathematical Art. *Mathematical Intelligencer.*

Innovative Learning Environments Research Group – Finnish Institute for Educational Research, University of Jyväskylä: https://www.jyu.fi/it/en/research/research-areas/cognitive-science-and-educational-technology/ile

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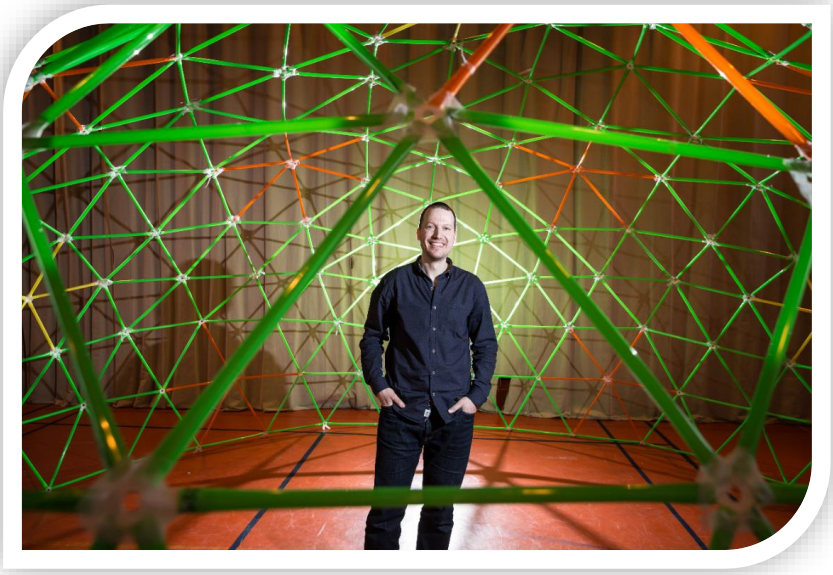

The Experience Workshop events are led by Dr. Kristóf Fenyvesi, Experience Workshop's CEO and Researcher of STEAM Education. Kristóf Fenyvesi, PhD (b. 1979) – is a researcher of STEAM (Science, Technology, Engineering, Arts and Mathematics) Trans- and Multidisciplinary Learning and Contemporary Cultural Studies in Finland, at the **Finnish Institute for Educational Research, University of Jyväskylä** (https://ktl.jyu.fi/en). He is the **Vice-President** of the world largest mathematics, arts and education community, the **Bridges Organization** (www.bridgesmathart.org). His main responsibilities include the coordination of the annual **Bridges conference's Workshop Paper track** and the **Bridges Family Day** (www.familyday.hu). From 2016, he is a member of the **European Mathematical Society's Committee for Raising Public Awareness**. Between 2013-2017 he served as **Chief Executive Officer of International Symmetry Association** (www.symmetry.hu) and in 2008 he started **Experience Workshop—International Math-Art Movement for Experience-oriented Education of Mathematics** (www.experienceworkshop.org). In 2016 he was invited by **European Commission** as a **STEAM expert for H2020 projects evaluation**. His main areas of research are mathematics and art connections in learning; STEAM education; inquiry-based, cooperative, playful and experience-oriented approaches in mathematics education; problem-solving in mathematics, in science and in art education; connecting hands-on activities and digital modeling in mathematics, science, art and design education; science & art connections in learning; phenomenon-based, multi- and transdisciplinary learning and co-teaching; inter-, cross-, multi- and transdisciplinary management and trans-curricular leadership in education; interdisciplinary aesthetics and philosophy.

Fenyvesi's articles have appeared on fora such as *The Notices of the American Mathematical Society*, *MAA Focus – Newsmagazine of the Mathematical Association of America, Nexus Network Journal, The Mathematical Intelligencer* and *Comparative Philosophy*. He has edited a number of math-art-education handbooks, including *Aesthetics of Interdisciplinarity: Art and Mathematics* (Springer-Birkhauser, 2017. Together with Tuuli Lähdesmäki) and other resources of mathematics&arts learning. He serves in the editorial board of several scientific journals, including Taylor & Francis' *Journal of Mathematics and the Arts*. He has been very active in organizing various international scientific events, education programs, exhibitions and STEAM festivals all around the globe.

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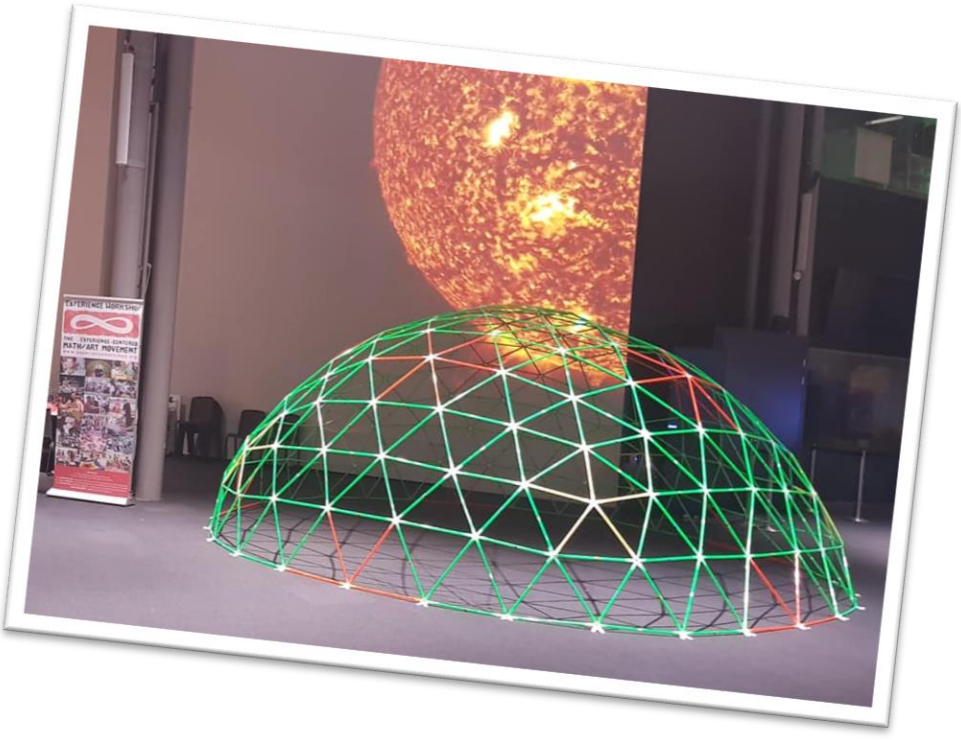
Professor Zsolt Lavicza

Linz School of Education, STEM Education Centre,

Johannes Kepler University, Linz, Austria

Professor Zsolt Lavicza **(**BA, BA, MS, MA, MPhil, PhD) after receiving his degrees in mathematics and physics in Hungary, began his postgraduate studies in applied mathematics at the University of Cincinnati. While teaching mathematics in Cincinnati he became interested in researching issues in the teaching and learning mathematics. In particular, he focused on investigating issues in relation to the use of technology in undergraduate mathematics education. Afterwards, both at the Universities of Michigan and Cambridge, he has worked on several research projects examining technology and mathematics teaching in a variety of classroom environments. In addition, Zsolt has greatly contributed to the development of the GeoGebra community and participated in developing research projects on GeoGebra and related technologies worldwide. Currently, Zsolt is a Professor in STEM Education Research Methods at Johannes Kepler University's Linz School of Education. From JKU he is working on numerous research projects worldwide related to technology integration into schools; leading the doctoral programme in STEM Education at JKU; teaching educational research methods worldwide; and coordinates research projects within the International GeoGebra Institute.



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