

SCIENCE IN ART NETWORKS

HOW ART AND EDUCATION
INTERTWINE IN THE PROJECT
“RHIZOSPHERE: THE BIG NETWORK
OF SMALL WORLDS”



Photo 1
Capture the Future(s),
exhibition interface,
AR application, 2021

As revolutionary advances in science and technology make the world increasingly complex, initiatives that combine science and art become more important than ever.

“Rhizosphere: The Big Network of Small Worlds” is a project that brings together art, science, and technology.

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Joanna Hoffmann

Studio of Transdisciplinary Projects and Research
University of the Arts Poznań

Marlena Lembicz

Department of Systematics and Environmental Botany
Adam Mickiewicz University in Poznań

The relationship between art and science has a long tradition: from the Pythagorean search for mathematical harmony, through the explorations of the Renaissance *humanists*, all the way to the avant-garde fascinations in the early 20th century. But this relationship gains special significance in the present-day era of the transition from one stage of civilization to another, comparable to other revolutions in the history of the human species. The ongoing transformations are determined and driven by rapid advances in science and technology, which have their roots in innovation and creativity, traditionally associated with art. But this is not the only reason behind the growing importance of art and art education, as reflected in the increasing popularity of art & science exhibitions and programs, as well as long-term interdisciplinary strategies in the area of STEAM (science, technology, engineering, the arts, and mathematics) that combine knowledge and methodologies from different fields.

Prominent physicist Werner Heisenberg believed that art was born from interactions between “the spirit of the times” and individuals. The spirit of the times, in turn, was strongly linked to the model of reality, shaped by advances in science and technology. Today’s reality manifests itself as a rapidly changing network of connections, a vibrant and self-organizing system of interactive data flows, ranging from neural networks to the World Wide Web and from river floodplains to social, economic, and cultural phenomena. Every microsecond is filled with countless interactions that connect all levels of our networked world.

This new model of reality requires the development of new strategies and communication structures that could break open the tightly closed economic, social, educational, and cultural systems inherited from the previous eras. This appears especially important in light of the ever-more acute local and global crises. Art and artists may play a special role in these processes. Roger Malina, founder of the Leonardo Art & Science Association, compared the present-day artist to a carrier in a river delta that connects various remote communities by carrying goods, information, and ideas, and promoting exchange and cooperation

between different communities. The journey itself is a value, an experience that enriches the content being conveyed and makes it more credible. The missions of present-day artists include creative exploration and the transfer of scientific discoveries and challenges into the broader sphere of human experience and imagination. However, in order to fulfill their avant-garde mission as “educators of perception,” artistic creations must go beyond the limitations of the system that is referred to as the world of art. It is no longer enough to travel to obscure regions, discover myriads of roads and crossroads, and swim with the meandering current of change. In a networked society, art can give birth to new structures of communication similar to delicate, constantly expanding hyphae that form the mycelium, thus stimulating the flow of information, knowledge, and experiences, and stirring inexhaustible sources of imagination. By working in an academic environment, artists gain access to the latest knowledge and technologies, along with the opportunity to join the dialogue between the exact sciences and the humanities, and then to pass on the artistically processed scientific knowledge to society in the form of works of art.

The idea behind the project

“Rhizosphere: The Big Network of Small Worlds” (art-science-node.com/rhizosphere-network/) is a project born from the need to open academic structures and communicate knowledge and experience, as well as from curiosity and the imperative of creation. The core of the project is formed by scientific research in the field of natural sciences, with artistic activities acting as drivers of the development of the network in multiple directions that create “rhizomes” of collaboration between various scientific and artistic communities. They facilitate the communication of scientific knowledge to various social groups, ranging from children to adults.

The structure of the project is modeled on underground biological networks of roots, rhizomes, and fungi that are referred to as the rhizosphere. It is a place where resources such as water, minerals, and products of photosynthesis are exchanged and where warning signals are sent out against herbivores, bacteria, and viruses to prepare for an upcoming attack. These networks, based on symbiotic associations, diversity, and interdependence, allow plants to grow, spread, and survive even in very adverse conditions.

The rhizosphere’s operating system is based on the model of the network of small worlds. Its effectiveness, measured in thousands of years, inspires the search for organizational solutions and strategies fostering sustainable development and a more efficient distribution of resources, information, and knowledge. It encourages actions that could open up



**Joanna Hoffmann,
PhD, DSc**

is a Professor at the University of the Arts Poznań and head of the Studio of Transdisciplinary Projects and Research (Faculty of Art Education and Curatorial Studies). She runs the Art & Science Synergy Foundation/Art & Science Node. As an artist, she works in the field of new technologies, virtual reality (VR), augmented reality (AR), multimedia installations, objects, and artists’ books.
www.johoffmann.com
joanna.hoffmann@uap.edu.pl



**Prof. Marlena
Lembicz**

is a botanist, a plant ecologist, a mycologist, as well as a certified tutor and education leader. She studies the environmental and evolutionary effects of the interactions between endophytic fungi and plants and animals. She is an enthusiast of mountain expeditions and Lower Silesia.
lembicz@amu.edu.pl

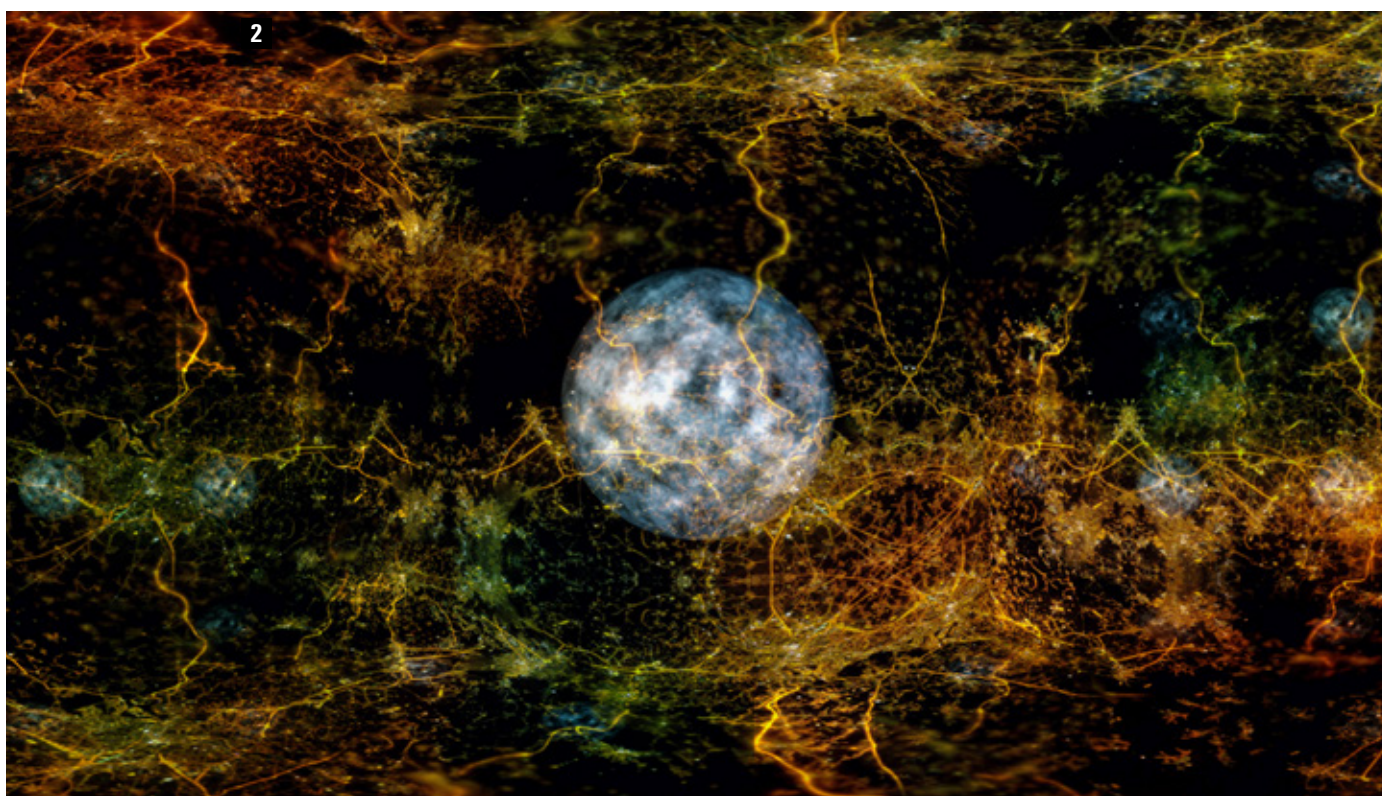


Photo 2
Joanna Hoffmann,
Rhizone: PapiLLa,
VR 360, 2021

areas of specialization, combine the experiences of various disciplines such as the arts, science, design, and engineering, and develop projects in which these disciplines could meet. This holistic approach not only stimulates cognitive processes but also fosters the development of entrepreneurial, creative, and critical thinking skills. Rhizosphere strategies become particularly important in light of the ongoing sweeping and rapid changes taking place in the social, cultural, economic, and environmental sphere, the crisis of the Anthropocene, and the growing responsibility that humans assume in influencing not only their own future but also the future of the entire planet. We have visualized the global human network as a rhizosphere that expands and connects all layers of our reality – a delicate web of symbiosis, diversity, and interdependence whose growth and prosperity are influenced by local actions.

Project history and authors

The project has been initiated and coordinated by Prof. Joanna Hoffmann. Since 2011, Prof. Hoffmann and her assistant, Piotr Słomczewski, have been developing a platform for collaboration between academic artistic and scientific communities within the Studio of Transdisciplinary Projects and Research, which is the first such unit in Poland. Thanks to its open program, students of the University of the Arts Poznań have access to the laboratories of the Faculty of Biol-

ogy of the Adam Mickiewicz University in Poznań. We organize various forms of joint interdisciplinary work: practical classes, workshops, consultations, lectures, seminars, and discussions. “Rhizosphere: the Big Network of Small Worlds” is a comprehensive project supported by an intercollegiate team where the Faculty of Biology is represented by Prof. Marlena Lembicz and Prof. Władysław Polcyn. In this academic year, the program has been joined by teachers and students from the Ignacy Paderewski Academy of Music in Poznań, the Electroacoustic Music Studio, and the Faculty of Mathematics of the Adam Mickiewicz University in Poznań. In the difficult conditions of the COVID-19 pandemic, regular online seminars for members of scientific and artistic communities are held to stimulate the exchange of knowledge and ideas and the development of artistic projects.

The Rhizosphere project started from Maria Subczyńska’s student art project called *Mycorrhizator*, inspired by research into mycorrhiza, which is a symbiotic association between a fungus and the root system of a plant. The artist’s imagination transformed mycorrhizal networks into a bridge connecting the Internet of humans with the “Internet” of plants. Over time, the *Mycorrhizator* took on the form of a growing, interactive installation that provided the basis for numerous interdisciplinary workshops, as well as art and education activities. Examples include the art and education workshop “A Journey Into the Underground,” organized by Prof. Marlena Lembicz and her

PhD student Martyna Dominiak, Piotr Słomczewski, and Jadwiga Subczyńska with technical support from the Poznan Supercomputing and Networking Center (as part of the program “School of the Future”). This unique and interdisciplinary workshop, which combines scientific knowledge and artistic strategies, was awarded the title “The best nature lesson EVER!” at the Tour Salon event in February 2019 at the Poznań International Fair, proving that art can be a great tool for communicating knowledge.

Artistic activity

The tangible outcomes of the activities taken up as part of the project include the exhibition *Capture the Future(s): Our Biotech Planet – The Routes to Roots Networks & Beyond*, shown at the Plant Biology Europe Congress 2021 in Turin (arts-science-node.com/our-bio-tech-planet/). It was organized by the Arts & Science Synergy Foundation/Art & Science Node, whose goals include working out new strategies for communicating scientific research and innovation through the arts. The concept of the exhibition comprised the artistic activities carried out as part of the Rhizosphere project and the works of artists-in-residence in science laboratories created as part of the Artists-in-Residence/Labs program run by ASSF/ASN as a partner in the Chicory Innovation Consortium (CHIC), supported through the EU Horizon 2020 Research & Innovation Program. The limitations imposed by the COVID-19 pandemic motivated the exhibition curators, Joanna Hoffmann and Karolina Wlazło-Malinowska, to use new technologies and media to boost the exhibition’s social impact.

Ultimately, the exhibition had the form of an original interactive website and an innovative augmented reality application. The interface of the rhizosphere exhibition has the form of a digital model of a plant root, deprived of any hierarchical structure and specific directions of growth. In the AR version, we can place it in any space we choose (Photo 1). The virtual root has interactive “nodules,” and each of them opens up a different world of artistic experiences. In turn, the website allows visitors to explore the inside of the root-shaped interface and discover the artistic narratives hidden in its labyrinth. To make navigation easier, the multifaceted and complex exhibition is divided into four zones: *Hybrid Realities*, *Living Systems*, *Tracing Links*, and *Shifting Horizons*.

Hybrid Realities opens with Jill Scott and Marille Hahne’s artistic project called *Aftertaste*, which focuses on the interactions that occur at the molecular level between the internal and external human environment. Viewers play the role of air, which is the medium that transfers molecules of terpenes and inulin, obtained from chicory roots, to the taste receptors placed on the interactive sculpture of a tongue. Anna Dumitriu and Alex May’s project *Biotechnology from the Blue Flower* evokes the idea of the *Urpflanze*, or Johann Wolfgang Goethe’s primal plant, thus creating a cultural bridge between the 19th century imagery and the challenges of modern-day science. The blurring of boundaries between biological and technological environments is invoked in the immersive project *RhiZone: PapiLLa* by Joanna Hoffmann with music by Andre Bartetzki. Inspired by the symbiotic processes in the rhizosphere, especially *Rhizobium*, the project

GLOSSARY

Terpenes (isoprenoids)
– organic chemical compounds that give plants their distinctive scent and taste, in addition to having medicinal and therapeutic properties.

Inulin
– a polysaccharide produced by plants and used as a prebiotic in medicine and dietetics.

Rhizobium
– a group of bacteria that form symbiotic associations with plants and cause the formation of nodules on the roots of those plants.



Photo 3
Joanna Hoffmann,
RhiZone: PapiLLa,
AR application, 2021

ACADEMIA RESEARCH IN PROGRESS Transdisciplinary Projects

Photo 4
 Larys Łubowicki,
Regnum Animale,
 photograph, 2020



asks questions about our identity in a world where organic and inorganic systems merge to form a new hybrid whole. *RhiZone: PapiLLa* is the imaginary organ of this new cybersymbiosis (Photos 2 & 3).

The *Living Systems* zone attempts to redefine the relationship between man and the natural environment. *Broken Links* by Maria Subczyńska and *Regnum Animale* by Larys Łubowicki (Photo 4) challenge anthropocentric attitudes, highlighting the need to maintain the balance and rich diversity of ecosystems and reconnect with their networks. In the performance *The*

Law of Relationship & Interdependence, Małgorzata Kaczmarek provides the plant with heat, moisture, and carbon dioxide from her body, and the plant produces oxygen, which the artist breathes. In turn Pei-Ying Lin's *Virophilia* pertains to the invisible yet omnipresent world of viruses.

Tracing Links presents processes that elude our direct perception. Sparse in form and color, Marta Bączyk's *Morphism* presents the animation of the contours of silhouettes from family photographs that form a drawing reminiscent of hyphae creating a tangled web in which no individual can be distinguished from others. In the series *Algorithmic Photography*, Alex May captures the imperceptible patterns created by flying birds, ant trails, and raindrops. Another artist using a specially designed algorithm is Piotr Słomczewski, whose project *Contactless Root Interface* presents a virtual root that follows the movements of the viewer to connect the digital and physical spaces (Photo 6). In *Defined_not*, Diana Taukin explores the potentiality of inspiration drawn from nature-based algorithms in modern-day generative design.

Shifting Horizons is a group of projects that propose to redefine orientations and perspectives that determine our visions of the future. Jadwiga Subczyńska's *Drifting Particles* depict an intelligent substance that has evolved from bioplastic and technology waste. The substance has no form and takes on anthropomorphic shapes, like a memory matrix of the world that already belongs to the past (Photo 5). In contrast, the same

Photo 5
 Jadwiga Subczyńska,
Drifting Particles,
 bioplastic, grains, 2020





artist's video entitled *Marsquakes* carries a message for humanity from the digital plants that have colonized Mars. Paulina Misiak, who has authored the series of works entitled *Call in*, changes our perspective and the scale of objects, thus inviting us to reflect on our entanglements in a reality informed by technology and business corporations. The exhibition's narrative ends with Joanna Hoffmann's audiovisual poem entitled *Vitruvian WoMan: Poem*. It directs the viewer's imagination towards a holistic conscious being that combines the evolutionary past, the present, and the future. This AR project physically engages the viewer in the process of discovering its audiovisual content. *Vitruvian WoMan* is inspired by the traditions of the Renaissance *umanisti*, who explored the relationship between humans and the universe. At the same time, it brings into focus the similarities and differences between the cultural revolution of the Italian Renaissance and our troubled times, often referred to as the New Renaissance.

Education

However, the renewed crossing of the paths of science, art, and technology, the pursuit of interdisciplinary discourse, and the creation of comprehensive and multifaceted knowledge should not begin at the academic level.

A very important aspect of the Rhizosphere and its educational mission is formed by workshops for children and young people and their integration into school programs. Last year, the Rhizosphere net-

works were expanded to include a permanent partnership with Primary School No. 2 in Dąbrówka outside Poznań. Under Vice-Principal Tomasz Ordza, the school is actively involved in the EU's eTwinning program for schools (integrated with the EU Lifelong Learning Program). The Rhizosphere also includes such projects as the international educational project "Wild networking – WiFi of plants and fungi," implemented in collaboration with schools in Portugal and Turkey and based on the STEAM method. Students from different backgrounds and cultures are working on a joint project, thus learning about the processes taking place in nature, getting to know new information technologies, and developing social skills (artscience-node.com/rhizosphere-etwinning/).

Building bridges

"Rhizosphere: The Big Network of Small Worlds" is an open network of emerging ideas and interdisciplinary communication "beyond divisions," which proves that art can be a driving force behind deep structural changes. As a form of social communication, art helps make knowledge more democratic and create relationships between individuals and the world around them, which in turn raises awareness of the transformations taking place in the world and engagement in such changes. Artists have a unique ability to transform complex scientific data into cultural and interpersonal narratives. In the Rhizosphere, artists are ambassadors that play a dual role by building bridges between closed scientific communities and the public. ■

Photo 6
Piotr Słomczewski,
"Contactless Root Interface,"
AR application, 2021

Further reading:

Heisenberg W., *Physics and Philosophy: The Revolution in Modern Science*, New York 1959.

Malina R., *Trzecia Kultura? Od sztuki do nauki i z powrotem*, *W Stronę Trzeciej Kultury*, ed. R. Kluszczyński, Gdańsk, 2011.

Alpert P., Stuefer J.F., *Division of labour in clonal plants* [in:] H. de Kroon, J. van Groenendael, *The ecology and evolution of clonal plants*, Leiden 1997.