

The environment of the convening

The Royal Zoological Society Natura Artis Magistra

In 1838, the wealthy Amsterdam citizens Westerman, Wijsmuller, and Werleman founded their zoological society with the aim of 'promoting the knowledge of natural history in a pleasant and imaginative way'. They called their brainchild *Natura Artis Magistra*, nature, the teacher of art and science. The vignette they used to promote their initiative illustrated what they had in mind (Figure 6). The Amsterdam City Maiden – the personification of the city–sits in the middle, accompanied by Mercury staff, Neptune trident, and anchor, which refer to the urban economy that provides capital for their investment. The City Maiden holds a laurel wreath above a folio with the initials NAM (*Natura Artis Magistra*). ARTIS is the traditional book of nature receiving praise. To the right of the Maiden, we see a collection of animals that represent the zoological orientation in the natural history interest of the founders. The world globe at her feet expresses a territorial claim: the Kingdom of The Netherlands as a colonial power that gives access to goods from afar (minerals, plants, animals, and objects). The roll of paper and compass refers to the construction and concrete spatial realization of this ideal: the park. Lyre, musical instrument, and book refer to Apollo, as the god of art and science. The monkey provides us with another key: he is not intended here as an animal in the collection but is an old symbol that stands for mimesis, for art and technique that imitate nature. This monkey indicates that the founders of ARTIS wanted to place themselves in a long tradition that defined the connection between nature and art. For example, in the Greco-Roman tradition, the Greek philosopher and astronomer Democritus stated that human beings 'are pupils of animals: of the spider in weaving and darning, of the swallow in building houses, and in singing of the swan and the nightingale by the way of imitation'. There was the statement by Lucretius, who wrote in his *De Rerum Natura* that nature is 'rerum creatrix', she is the first artist. Goethe paraphrased this by writing that 'Die Natur ist aller Meister Meister', 'Nature is the mistress of all masters'. It is a concise expression of this essential truth for art and science, which has been published since the 16th century in the countless treatises on art, science, and architecture. Nature as the most highly valued source of inspiration that could become again commonplace in our daily conversations.



Figure 1. Vignette of the annual report from the royal zoological society *Natura Artis Magistra* (1854). Collection of the ARTIS-library.

ARTIS-Park as a cohesive work of art

ARTIS-Park is a green lung in Amsterdam, with an enclosed area of approximately 14 ha. A home for over 400 different species of animals: from elephants to rabbit owls, from chimpanzees to salamanders. A place where humans can connect with other animals and experience nature away from the city's hustle and bustle. Somewhere to stop and marvel, not only in the animal kingdom but also at the intersection where humans and nature meet. With over 200 different species of plants, dozens of works of art, 26 national monuments, 1 municipal monument, and two museums, ARTIS is not only a zoo but also an (open-air) museum, monument garden, and botanical garden.

The Royal Zoological Society, *Natura Artis Magistra*, was founded in 1838. It began with a limited plot near the intersection of Plantage Middenlaan and Plantage Kerklaan. There the society fulfilled its ambition to study and collect both living and dead nature. The original entrance gate to ARTIS was located on Plantage Middenlaan, near the bridge over the then New Prinsengracht, but because of the construction of the Main Building (the current Groote Museum), this entrance gate was demolished. Since 1851, the entrance has been on Plantage Kerklaan.

In addition to the all-important curiosity about the animal world, the Natura Artis Magistra Society has focused on park design, art, and architecture from the very beginning. This came in handy because, with rapidly expanding membership and animal population, there was constant change and innovation. Membership grew rapidly in the early decades, and the territory of ARTIS expanded in several stages between 1838 and 1877 to almost its current size. Only one more land expansion occurred in the twentieth century.

The distribution of various buildings across the ground was established according to an organic process, and the surrounding pathway structure was landscaped. Various sculptures, grave monuments, and garden furniture, such as benches and flowerbed fences, are located or have been located on the ground. In addition, older pre-existing buildings have been incorporated into the ARTIS Park. The styles of the various buildings and structures are very diverse: classicist, exotic, chalet-style, romantic, or business functional. Several national monuments have undergone restoration to match the current views on animal welfare and be more sustainable.

With the motto 'Nature is teacher of art and science', the gates of ARTIS were opened to artists early after its founding in the nineteenth century and their works of art graced the buildings and park. Donations also expanded the collection of artworks. The sculptures are an inseparable part of the park and its history. They often symbolize a special relationship between humans and animals, pay tribute to directors or iconic animals, or illustrate the ethnographic interests of nineteenth-century society.

Since 2020, ARTIS has officially been a botanical garden and thus a guardian of biodiversity. ARTIS maintains and protects many species of plants and trees, including species no longer found in nature in the Netherlands and species that no longer exist in the wild anywhere in the world. In addition, ARTIS has an edible garden since the summer of 2014 [1]. All temporary plants are edible for both animals and humans. This not only provides a varied diet for the animals but is also beneficial for biodiversity, as well as reducing waste and excess transportation. ARTIS is an ensemble, with living and dead collections. Buildings, sculptures, animals, trees, art, and plants are combined to create ARTIS. They form a cohesive work of art in which different collections come together to form a greater whole than the sum of its individual parts.

Impact of the unseen majority of life at ARTIS-Micropia

ARTIS-Micropia is the world's first and only microbe museum [2,3]. Here, visitors encounter living microorganisms in a museum or a 'microbe zoo.' Micropia adds an important new chapter to ARTIS' long tradition of nature education: an enlightening experience with the unseen majority of life: the most abundant and at the same time smallest organisms on Earth. Microbes shape the planet. The metabolic activity of microbes forms an intrinsic part of all nutrient cycles on Earth, and accordingly, knowledge about microbial physiology can help address urgent environmental and health problems. From the purification of drinking water to the development of renewable energy sources, and novel fermented food products that contribute to the transition from animal to plant proteins. The applications that play a crucial role in microbial activity are endless.

However, a serious knowledge gap exists between science and the public. If there is any general view of the invisible world of microbes, it is often a negative one. Microbe literacy is essential to understand life on Earth [4], as microbial life is intricately connected to all other life forms, forming an essential key towards a sustainable future for the planet and its people. ARTIS-Micropia wants to

inspire the public by encouraging interest in invisible living organisms from a very early age. With the help of living microbes, it offers a hopeful look into our future, our health, and the health of our planet.

ARTIS-Micropia shows that everything is connected through vital links between microbes and metazoans (Figure 7). Microalgae, for instance, microscopic plant-like organisms, not only produce about half of the oxygen in our atmosphere, but they also constitute nature's biggest food source, powering important food chains on the planet. We do not even have to look that far to find the essential roles of microbes. We can simply observe ourselves. In fact, we are more microbial than humans in terms of the cell number. The human microbiota, the communities of microorganisms that share our body space comprising of a vast amount of bacteria, archaea, viruses, and fungi - the number of bacteria alone has been estimated to 38 trillion [5], harbors an enormous metabolic potential. While the human genome consists of only 23 thousand genes, the collective number of genes in the microbiota adds up to three million, allowing the production of thousands of metabolites, particularly in the gut, affecting the host's fitness and health via systemic circulation and the neuroendocrine system [6]. Through the gut-brain axis, the gut microbiota has a direct impact on human behavior [7]. All this, of course, is not unique to humans. Every species on Earth depends on microbes. Each species harbors its own unique microbiota: just like mammals depend on their gut microbiota, plants depend on the microorganisms around their roots in the soil in the so-called rhizosphere microbiome [8].

Unfortunately, humans have become increasingly disconnected from nature because of industrialization, the built environment, dietary changes, medical use, and increased hygiene standards. Accumulating evidence suggests that lifestyle factors affect the composition and diversity of the human microbiome [9]. This affects our immune health, as the immune system is a learning system that requires 'data input' from microbiota in the gut and natural environment. The decrease in these inputs contributes to the failure of immune system regulation and results in chronic inflammatory disorders, including allergies, autoimmune diseases, and inflammatory bowel disease [10]. Therefore, ARTIS-Micropia not only shows its visitors their personal connection with the countless microbes in their body but also encourages them to reconnect with nature and harness microbial symbiosis through lifestyle and diet. The essential role that microbes play in our health contributes to the notion that humans are part of nature, and our health cannot be separated from the health of our environment' [11].



Figure 2. ARTIS-Micropia Microbe Museum.

The bigger picture in the ARTIS-Planetarium

ARTIS can show nature within its full range. From the smallest to the biggest structures of life. From the invisible to the infinite. With the ARTIS-Planetarium, we have an instrument that connects to nature on different scales [12]. A double lens shows nature from a universal and global perspective. First by looking up. Learning about the building blocks of life and understanding our isolated position. ARTIS-Planetarium visualizes the accumulation of interstellar gas under the influence of gravity, thereby creating stars. The nuclear power plants of the universe create all the elements, including you and me. As the astronomer Carl Sagan once said, ‘The nitrogen in our DNA, the calcium in our teeth, the iron in our blood, the carbon in our apple pies were made in the interiors of collapsing stars.’ Therefore, we are made of stardust. In addition, the ARTIS-Planetarium shows our position in this vast universe, which is extremely isolated. Even though there are discoveries of exoplanets, the promise of a ‘Second Earth’ in our Milky Way, find their way to press releases almost every month. However, a journey to even the nearest star using today's technology will take tens of thousands of years. There is only one place called home, our ‘Spaceship Earth’ [13]. Indeed, the term Spaceship Earth has been useful in highlighting both resource limitations and the beauty and fragility of delicate ecosystems that sustain life’ [14]. It is the only oasis in the vast desert of space.

From this realization, we use Planetarium's second lens, looking downward from space towards our planet (Figure 8). This creates a strong emotional effect. Astronauts call this the overview effect’ [15]. It is the experience of seeing firsthand the reality of the Earth in space, which is immediately understood as a tiny, fragile sphere of life hanging in the void, shielded, and nourished by a thin paper atmosphere. From space, national boundaries vanish. The conflicts that divide people have become less important, and the need to create a planetary society with the united will to protect it has become both obvious and imperative.

The focus of space engineering has shifted from prestigious political missions to the collection of big data [16]. Every day, Earth is monitored on a global scale. This includes tracking global warming, measuring air quality, following animal migration, calculating the impact of agriculture, and predicting ocean currents and weather patterns. The ARTIS-Planetarium uses satellite data to provide insight into the global problems faced today. These measurements can be used to track the impact on the planet and extrapolate the findings to sustainable scenarios for future planetary health. Accordingly, the Planetarium shows the audience's future solutions, allowing for the preservation of nature from a global perspective.



Figure 3. The Planetarium's second lens: algae bloom in the Baltic Sea. Phytoplankton provides 50% of the oxygen on Earth. Credit: ESA Copernicus Sentinel Data.

Reflections about life at ARTIS-Groote Museum

The Groote Museum [17] was the first museum in Amsterdam, founded in 1855 by the Royal Dutch Zoological Society *Natura Artis Magistra*, organizing gatherings for members only to contemplate nature [18]. Recently, this tradition has been revived as the Groote Museum has been closed for 75 years and has reopened its doors to the public on May 9, 2022 (Figure 9). The ARTIS-Groote Museum is the museum of big questions – the first thing you encounter is a big question mark, from different angles about us and our relationship with nature. A museum that one enters with many questions, and leaves with even more. All the current public gatherings in the museum, four per week, start with questions: What will be the food of our grandchildren? Do my eyes see the same things as yours? Why do smells convey such strong memories? Is emptiness really nothing? During these

gatherings, visitors learn about these questions and the theories behind them. The starting point of each visit was the visitor, in the most literal sense. All visitors to the museum obviously bring their bodies and use them to reflect upon nature. The human body acts as a mirror for understanding the surrounding world. The museum consists of 14 zones: a gathering zone, a question mark, and 12 body parts. The zone 'heart' for example is not so much about a lesson in human physiology, but about the big themes associated with the heart: the circulation of blood, the rhythm of life, synthesis, and decay. The zone 'brain' is about intelligence, and you will be challenged to test your short-term memory in a competition with a chimpanzee. The zone 'hands' is linked with tools, craftwork, manufacturability, simply everything humans have created. Will this save or destroy humanity? You are invited to discuss this with a professor of philosophy at the back of the room. The zone 'ears' is about our relationship with sounds. The sounds of living organisms, nature (wind and rains), and everything we made (trains, music, cars). Is this a blessing or a curse? The underlying goal in every zone is to understand the impact of humankind on the surrounding world and its natural systems and reflect on this relationship. If you understand this relationship, you will feel more connected. If you are more connected to nature, you will be more compassionate and willing to act in the interest of preservation. Upon entrance, the visitor of the museum is invited to the big question mark to select a zone, check the zone, and input two words that come to mind after visiting using the museum's mobile phone application. The visitor starts with the assignment at the question mark, and by the end, these words add up as an unintentional poem about life (Table 1).

<i>Life is ...</i>	<i>Life is ...</i>	<i>Life is ...</i>
of uuuhhhh and bad	of beautiful light and history	of nourishment and segment
of interesting and fascinating	of thought and creativity	of shell and structure
of repair and re-use	of fertile and connection	of neurons and dirk gently
of pacemaker and move	of tech and question	of rhythm and cycle
of green and life	of craft and greed	of similarities and navel
<i>All this - and more - is life</i>	of connection and emotion	of handy and resourcefulness
	of embellish and exacerbate	of hard and confusing
	<i>All this - and more - is life</i>	of trace and walk
		of move and dance
		<i>All this - and more - is life</i>

Table 1. Unintentional poetry about life. Three unintentional poems were written by three Planetary Health European Hub members at the ARTIS-Groote Museum on September 26, 2022.



Figure 4. The West wing of the ARTIS-Groote Museum. Photo credit Maarten van der Wal.

Our views on nature at the ARTIS-Library of Natural History

In 1838, the founders of the society *Natura Artis Magistra* aimed to collect living nature in the garden and to present dead nature in a museum. Soon after, a third goal was added: nature on paper, to gather information about that part of nature for which simply was no place in the garden or in the museum. The building in which the library is still housed dates to 1868 and was designed by Gerlof Salm (1831-1897). Manuscripts, printed books, drawings, watercolors, periodicals, and archives are the most beautiful of what the history of natural history has to offer. Although the early members of the society were granted access to the library, its collection was very rarely visited. This somewhat changed after the founding of the University of Amsterdam in 1877. In return for a piece of land on which ARTIS wanted to build an aquarium, students and staff at the university were allowed to use the ARTIS collections. However, books and manuscripts were not frequently consulted.

In 1939 the society faced serious financial problems, and the city of Amsterdam took over the debts. The terrain and the animals remained in possession of the society, and collections of the museum and library (the library building included) were given to the care of the University of Amsterdam. The museum collection became a part of the Zoological Museum of Amsterdam. This collection was handed over to Naturalis in Leiden in 2013. The library building was sold back to ARTIS in 2017 under the conditions that the building would be renovated (which was necessary because the foundation of the building was rotten) and that the collection of the library could remain in its original housing for at least 30 years. Because the foundation was in an even more problematic state than anticipated, the renovation was imminent. This work was initiated in 2019. In March 2022, the reading room collection of the ARTIS Library was moved back to the renovated building.

Since 2005, the collection has become one of the heritage collections of the University of Amsterdam, recently renamed the Allard Pierson collection. All activities in the library serve the core

goals of the university; research, education and what now is called ‘valorization,’ which aims to make the results of research and education visible to a large audience by means of presentations, exhibitions, and publications. When library courses are being taught, researchers are studying the collection, symposiums are being held, and many presentations are being given. Primarily about natural history, but also art history and book history, among which are illustration techniques. Since the university promoted the building and its collection, not only more students and researchers found their way to the library, but also increasingly the broader public. Currently, approximately 2500 people a year visit the library. Which is no surprise, considering the collection still is in its beautiful nineteenth century surrounding, with in place its magnificent manuscripts, printed books, drawings, and watercolors, made and written by people like Maria Sibylla Merian, Carolus Linnaeus, François LeVaillant, John Gould and Charles Darwin of whom the library even holds letters written to Hugo de Vries, the Professor of Botany from the University of Amsterdam.

A major course taught at the ARTIS-library is ‘The discovery of nature’ [19]: ‘The natural sciences have a rich history, which is closely interwoven with other fields of knowledge, such as geography, anthropology, economy, and the arts. This course aims to introduce and illuminate this history in its context. Central is the question: How has humankind viewed, researched, and interpreted nature from the sixteenth to nineteenth century? And how does this relate to our present-day knowledge and attitude towards nature?’ One may wonder if there is anything more relevant for planetary health than to fully understand our attitude towards nature and find ways to live with it in harmony.



Figure 5. The ARTIS-Library of Natural History. Photo credit Maarten van Haaff.

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