CENTRUM NAUKI KOPERNIK

10 YEARS

W poniedziałek
Skłodowska-Curie odkrywa rad.

A Kopernik? Jest otwarty!

Annual Report 2019

Cover illustration: A poster used in the campaign to promote attendance, after the Copernicus Science Centre began opening on Mondays.

Foreword

More than half of the Polish public feel that we will be worse off 20 years from now than we are today. That the world will become more complicated, interpersonal relations will deteriorate, and technology will not be used to our benefit. Most people feel that we will be sinking under mountains of trash, that artificial intelligence will pose a danger instead of helping us, and that social inequalities will be increasing and deepening.

Such is the surprisingly pessimistic view of the future that emerges from the results of a survey carried out in 2019, commissioned by the Copernicus Science Centre.[1] Surprisingly so, because on the other hand nearly all the statistics show that Polish people's standard of living continues to improve. The average lifespan is getting longer. We are driving better cars, we enjoy widespread Internet access and are drawing fully upon the benefits of modern technology, which is helping us resolve important problems and making our lives more convenient. Medicine is advancing, so treatment is gradually improving. This does not mean, of course, that we do not have serious problems to resolve, but the progress we have made does not justify such pessimism.

In the deluge of bad news, it is nevertheless hard for us to evaluate the great change that is taking place before our very eyes. Change that, in large part, we owe to science and technology. We feel a bit helpless in the face of forecasts of new, unknown and potentially menacing phenomena that have yet to come. We are worried by the degradation of the natural environment and by climate warming, which could bring catastrophic consequences within our lifetimes. A vast majority of members of Polish society (72%)[2] have no doubt that we humans are ourselves to blame for the climate crisis, though we do not know how to remedy the situation.

The pessimistic vision of the future may give rise to various reactions: to apathy, fear, radicalism, or conversely – to denial and rejection of knowledge that instils profound discomfort. Neither of these stances will bring us nearer to solving problems. That is why we at the Copernicus Science Centre focus our programme on supporting the development of competences that enable people to understand the world better and encourage responsible action.

The year 2019 was a fruitful one for Copernicus. Even more individuals than in previous years independently experimented with our exhibits and in our labs, discovering how the world works, and they gave us better reviews of the experience we have to offer. Thanks to the "Science for You" programme, we were able to reach out to more than 90,000 school students in small towns. The Young Explorer's Clubs (YECs), of which there are now 700 operating, ensured the intensive development of educational activity in local communities. Through thought-provoking events (such as the Przemiany Festival, this time focused on the future of food), we confronted various scenarios for the near future and considered our role in making this world better. We can therefore close the year 2019 with a conviction that we have managed to provide many individuals with an experience of the rationality of the seemingly irrational world, and encourage them to feel greater agency.

In her superb Nobel address, delivered on 7 December 2019 at the Swedish Academy in Stockholm, Olga Tokarczuk said: "Life is created by events, but it is only when we are able to interpret them, try to understand them and lend them meaning that they are transformed into experience. Events are facts, but experience is something inexpressibly different. It is experience, and not any event, that makes up the material of our lives. Experience is a fact that has been interpreted and situated in memory. It also refers to a certain foundation we have in our minds, to a deep structure of significations upon which we can unfurl our own lives and examine them fully and carefully."[3] At Copernicus, we speak of facts and phenomena, but we concentrate on personal experience, that imposes sense upon learned facts. And so, I'd like to wholeheartedly encourage all of you to take part in our activities, described herein.

Robert Firmhofer
CEO, Copernicus Science Centre

1 Survey commissioned by the Copernicus Science Centre, conducted on the nationwide Ariadna Online Panel in September 2019 on a nationwide sample of 1012 people aged 15 and older.

2 As above.

3 Olga Tokarczuk – Nobel Lecture. NobelPrize.org. Nobel Media AB 2020. 20 Jan 2020. <https://www.nobelprize.org/prizes/literature/2018/tokarczuk/104871-lecture-english/>

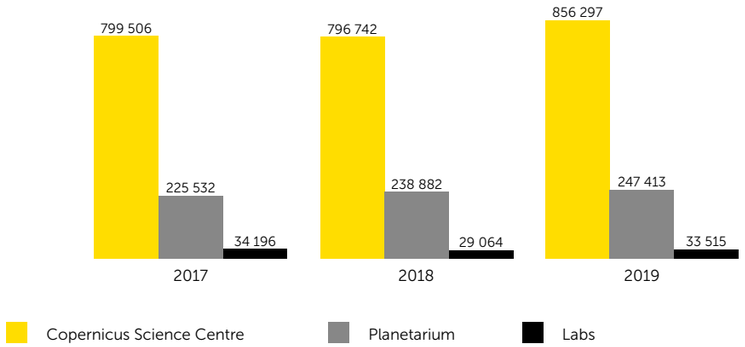
Part 1. Our visitors

On a Monday Armstrong first stood on the surface of the moon. How about Copernicus? We are open on Mondays!

In May 2019, we received a letter from an organiser of a school trip imploring us to open our doors at night. He explained that the usual tickets had sold out, and that his students would happily pull an all-nighter for a chance to visit the science centre.

Copernicus is as popular as ever! In spite of growing competition from new science centres and other ways of spending free time, we ended 2019 with our second highest attendance: **1,190,050 visitors**.

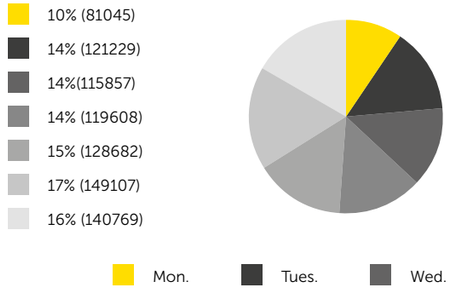
Attendance



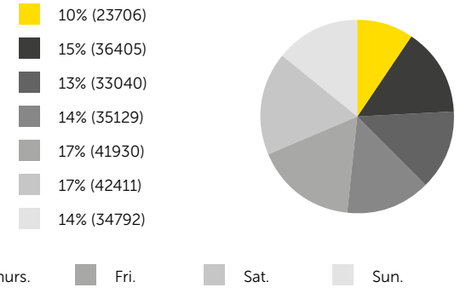
It can be difficult to get tickets to Copernicus at the most popular times, so we decided to extend our opening hours. In spite of the kind letter described above we did not actually consider starting night shifts, but instead found another opportunity. Like almost all museums in Poland, Copernicus has always been closed to visitors on Mondays. This is especially important for science centres, since the day is used to conduct repair and conservation work. However, **since 2019, Copernicus has been opening its doors to the public on Mondays, apart from the first Monday of the month.**

Last year, our exhibitions were available for an additional 39 days; this translates into 120,000 spaces, for which we sold approx. 81,000 tickets. The Planetarium was open on an additional 35 days (the venue was closed for more extensive renovation work throughout September), which translates into 35,000 spaces at shows and 24,000 tickets sold.

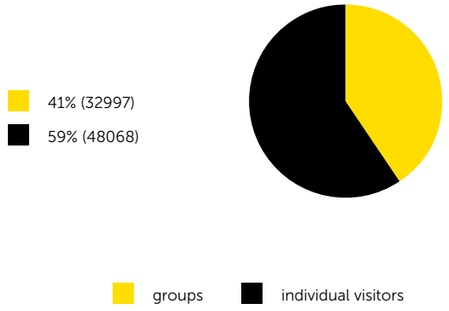
Attendance at the Copernicus Science Centre – weekdays and weekends



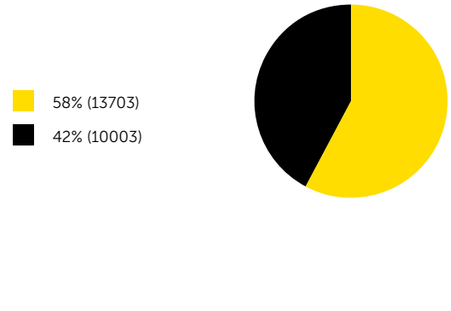
Attendance at the Planetarium – weekdays and weekends



Mondays at the Copernicus Science Centre – type of visitor

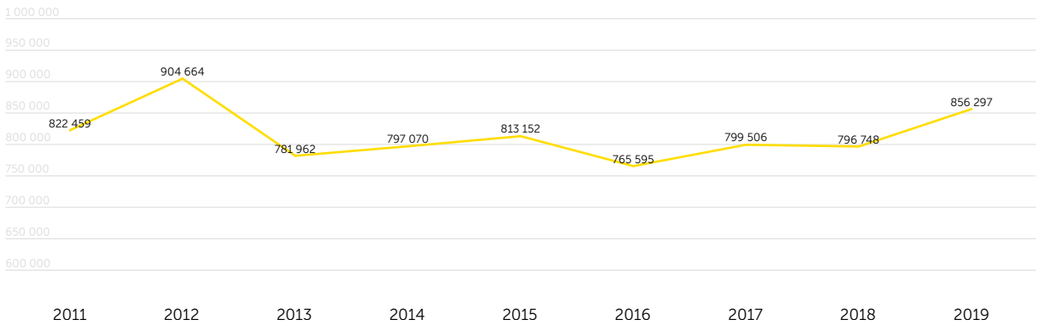


Mondays at the Planetarium – type of visitor

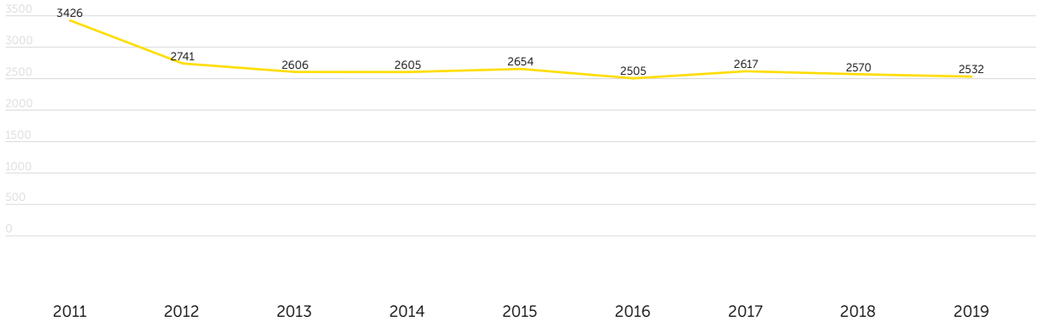


By extending our opening hours we are meeting one of our strategic goals: to provide top quality experiences for the million visitors we receive every year. By opening on Mondays, we have improved accessibility and improved visitor comfort: we have limited the number of people able to attend exhibitions at any given time, which means the space is less crowded and noisy.

Number of visitors on an annual scale – Copernicus Science Centre

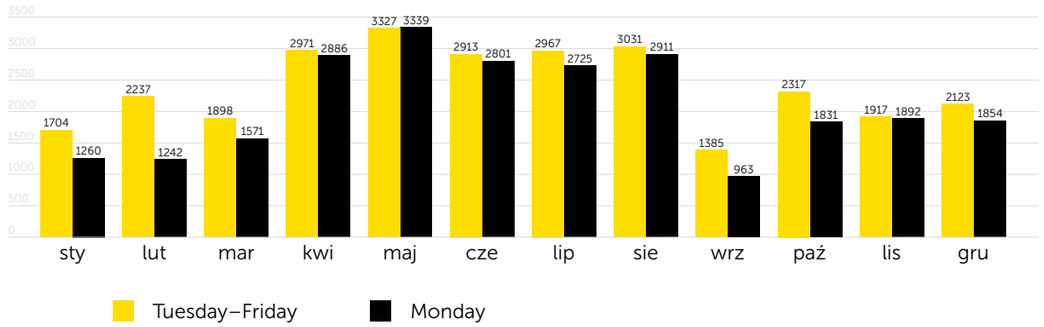


Number of visitors on a daily scale – Copernicus Science Centre

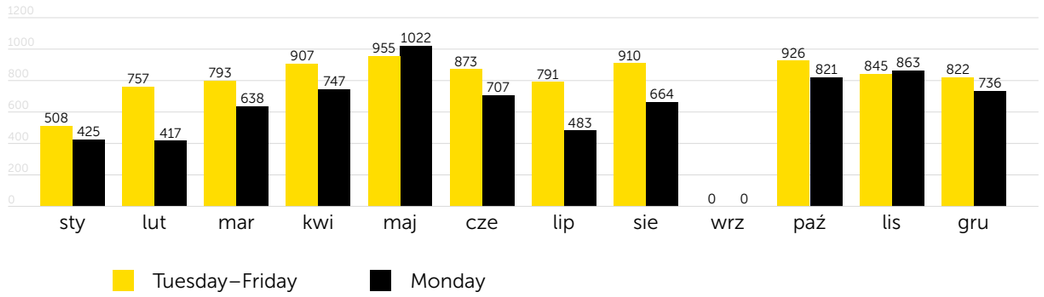


Our visitors are gradually getting used to the idea of Monday opening. As the year went on, growing numbers of people decided to start their week by visiting us. This is especially notable at the Planetarium: in certain months, Mondays were actually more popular than other days.

Copernicus – daily average – Mondays vs. other days

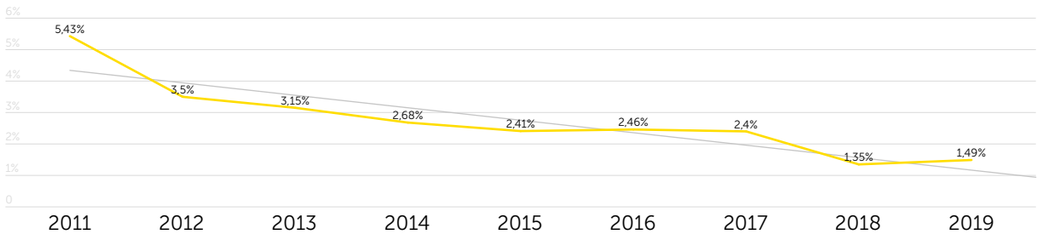


Planetarium – daily average – Mondays vs. other days



The change posed a major organisational challenge, since it required devising a new rota for our explainers and shifting technical work to night hours. And we were certainly up to meeting both challenges! Shifting maintenance and repair work from Mondays to night-times during the week has had no negative impact on the service we provide. We maintained the designated level of always keeping **97% exhibits fully functional**. While our visitor numbers increase year on year, the failure rate of our exhibits is dropping (more about maintenance work on p. 13).

Average breakdown rate of exhibits on an annual scale



School groups

Thanks to the new municipal programme **Class in Warsaw**, **Warsaw with Class**, students at schools in the city were able to participate in extracurricular activities at institutions of informal education for free. Between the start of October and the end of the year, we were visited by 427 school groups, with 8,676 students and teachers attending our exhibitions and 7,404 watching presentations at the Planetarium.

As part of the programme, we have also developed activities for teachers to further **increase the numbers of school trips**. By surveying opinions of teachers following their visit to Copernicus, we gathered more information on how to improve their visits to maximise their educational outcome. We prepared information brochures outlining our activities in the context of curriculums from preschool to high-school level. We also hosted workshops for teachers as part of the temporary exhibition Measuring Man (more on p. 14) to help them prepare for their visit to Copernicus, as well as developing a simpler system of booking group tickets.

Individual visitors

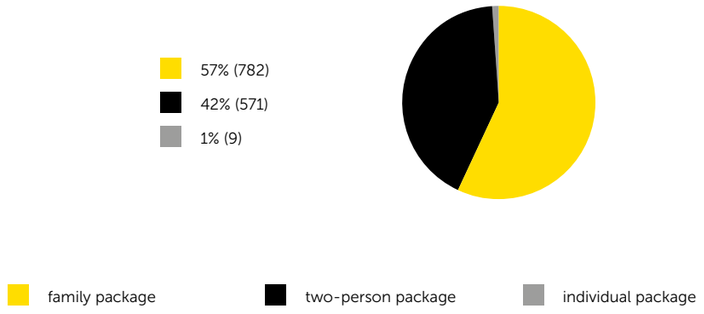
Individual guests remain the largest proportion (66%) of visitors to our exhibitions and the Planetarium. The remaining 34% tickets were sold to groups. The numbers are similar to those from 2018, with 64% of all tickets sold to individuals and 36% to groups. We are also attracting growing numbers of tourists, visiting Copernicus as part of their trip to Warsaw. In 2019, we held two promotional campaigns targeting tourists: "Holiday on the Moon? We Fly There Every Day!", launched at the threshold of the summer and marking the anniversary of the Apollo 11 mission, helped us achieve an attendance of 231,981 during the summer months (the equivalent figure for 2018 was 204,036), while the "Stay at Copernicus" campaign launched in September brought in 137,289 visitors in September and October. The latter figure does not initially sound impressive in comparison with last year (154,170 visitors), but it should be noted that the Planetarium was closed for renovation work for six weeks during the period. Since September, tourists have also been able to buy tickets to Copernicus via the popular website booking.com. During a trial period we sold 656 tickets by the end of December.

Copernicus Club

Our visitors include people who visit Copernicus time and again. Our loyalty programme, the Copernicus Club, was created especially with them in mind. We closed 2019 with 1,362 members –the highest number since the launch of the club. Some club members have been with us for four years – we are delighted that they show that Copernicus is worth returning to.

Benefits of membership include free unlimited entry to Copernicus throughout the year and tickets for special events. We held 101 such events in 2019, with 1,525 tickets reserved for club members. They included premieres held at the Planetarium (screenings of "Faster than Light" and "The Eagle has Landed"), tests with participants of "Measuring Love" science show. tests with participants in new activities at the EduFactory, evaluations of a brand-new exhibits and pilot workshops for parents at the Buzzz! exhibition.

Copernicus Club 2019



Media

We communicate with our visitors online via our website and social media. In 2019, there were 1,486,010 hits on the Copernicus Science Centre website, 311,228 on the Planetarium website, 5,295 hits on the FameLab competition website, and 52,116 hits on the Przemiany Festival website. The Copernicus Science Centre has 174,127 Facebook fans, while the Planetarium has 26,502 fans. We also host separate Facebook pages for individual events. The Science Picnic has 16,535 fans, the Przemiany Festival has 12,907 fans and the FameLab Competition has 5,455 fans. Copernicus has been tagged 404 times in online videos and 3,200 times in photos.

Our visitors are also kept abreast of events via traditional media. In 2019, there were 31,200 publications covering Copernicus, including 11,742 on Facebook, 9,436 online, 1,680 on the radio, 765 in the press, 2,740 on Twitter, 670 on TV and 263 on blogs.

Part 2. Exhibitions

Permanent exhibitions

Our permanent exhibitions consist of the **Experimental Zone**, the **Re:generation** exhibition, the young children's exhibition **Buzzz!** and the **Look: There's the Earth** exhibition at the Planetarium. We are constantly working on improving and modernising our exhibitions and making them more attractive, aiming to meet one of our four strategic goals: to provide top quality experiences for the million visitors we receive every year. This quality stems from the way we have designed what we offer to satisfy people's innate curiosity and desire for discovery. We strive to present our exhibits in accessible, comfortable surroundings using simple, intuitive solutions to make sure everyone's visit to Copernicus is fun as well as being educational.

We also renovated the green roof of the main Copernicus building. The roof is closed to visitors during winter, but it will reopen once again in spring, offering commanding views over the city from among greenery. We have recreated a riverside landscape, with paths meandering among planters filled with blooms and craters serving as skylights.

Away from the public eye, our workshops are toiling away to find innovative ways to enhance our exhibits or replace out-of-date or worn out displays. In 2019, we unveiled some more brand-new exhibits, including an installation by the American artist and engineer Dan Chen. The **End of Life Care Machine** is a robot tasked with comforting dying patients in their last moments. The exhibit provokes reflection on the boundaries of human intimacy and whether they can be crossed by machines. David Durlach's **Dancing Trees** has been added to the Experimental Zone. Electromagnets create a magnetic field, within which iron filings move and swirl to create spiky patterns and structures as they "dance" to different tunes. By moving their hands over the touchscreen, visitors switch individual electromagnets off and on to create different shapes.

Keeping exhibits in tip-top shape....

We encourage our visitors to engage with our exhibits, and so the objects and devices need to be highly robust. Such regular, heavy use means we are constantly fixing and repairing things. In 2019, we set ourselves a limit of always keeping 97% of all exhibits fully operational, a notch up from the previous limit of 95%. In December 2019, our average was over 99%! As well as carrying out repairs, we are also constantly improving and modernising our exhibits.

...and building new ones

There is no simple recipe for selecting natural phenomena to highlight and choosing ways of presenting them, combining aesthetics with ergonomics while also making sure they follow strict safety regulations. **Our exhibits are created through an extensive R&D process**. We devise prototypes, then analyse how our visitors behave when using our exhibits, how they learn to use them and interact with them; the entire process is a study in physics, biology, physiology and learning processes. We keep working on prototypes until we are confident that they provide the best possible quality of experience. The exhibition space acts as a laboratory where we test our latest ideas and investigate how our visitors respond to them. All these tests help us create intuitive and fascinating installations.

In 2019, we tested "Puff" – the working name of a prototype device which our visitors will be able to blow into to create donut-shaped clouds of vapour and observe their impressive stability. These little clouds result from the very same laws of physics as govern the stability of tornadoes and volcanic clouds. We have also been testing an exhibit which will allow visitors to observe water crystallising under low temperatures. Viewed through polarising foil, the crystals present myriad shapes and colours. The prototype is based on an ice cream maker.

Prototyping the Welcome Zone

We want our exhibitions to inspire visitors' curiosity and motivate them to ask questions and conduct experiments themselves. Our evaluations frequently reveal that guests see our exhibits as fun and entertaining toys, but they do not see their educational value. This is most frequently flagged by teachers. We have responded by developing a prototype of a new **Welcome Zone** – a research station showing visitors what they can learn at Copernicus, where and how.

We tested a prototype of the Welcome Zone with our visitors, wanting to find out more about their needs and about their opinions regarding our proposed solutions. The Welcome Zone had two main objectives: to help visitors properly gain their bearings within the Exhibitions, so they can best choose what direction to head in, and to inspire them to adopt a model of observation and experimentation, of posing questions and seeking answers, so that their visit to Copernicus will yield as many educational benefits as possible. Here, of course, we are talking not about "hard" knowledge but about learning methods themselves, based on inquiry and experimentation. However, test results showed that the scenario meant to inspire visitors to engage in active experimentation actually failed to perform its intended role. The maps meant to help visitors get their bearings within the exhibition space, on the other hand, did prove useful, but during the research suggestions were made to further expand upon the whole information system providing orientation within the Copernicus facilities. The recommendations so developed, concerning both the maps and the scenario, will now help us in developing a new prototype for the Welcome Zone.

Temporary exhibition Measuring Man

We also keep things fresh by regularly adding new temporary exhibitions. At **Measuring Man**, visitors can measure their height, weight and how long their limbs are. At the exhibition, visitors can also learn more about their bodies by testing their heart rate, lung capacity, muscle electroactivity, precision of movement, sensitivity of touch, speed of reactions and eyesight adaptation.

There are forty exhibits, thirty-one of which come from the original **Measuring Man** exhibition at Technorama and nine brand-new displays which were developed at Copernicus. Visitors explore various quantifiable features of reality by conducting direct measurements. By measuring our bodily fitness, capacity, reflexes and accuracy, we confirm that in a sense, humans can indeed be quantified. The exhibition aims to inspire visitors to reflect on the questions it poses and more. And of course we're on hand to help out a little.

Samsung Electronics Polska Sp. z o.o. is our partner for temporary exhibitions.

Workshops preparing teachers for the Measuring Man exhibition

Workshops held as part of the Measuring Man exhibition introduce teachers to the exhibits and help them prepare for their trip, conduct the actual visit and make the most of this experience in future lessons. Workshop participants can also use a simpler system of booking group tickets for their visit with their pupils.

The programme of our workshops is based on comments from teachers who have expressed concerns whether they will be able to use the educational potential of their visit in future lessons. Some of the issues they brought up include distracting noise in the exhibition space, confusion resulting from the lack of museum guides and difficulty in using the exhibits.

Evaluations indicate that after attending the workshops teachers feel better prepared for their visit and have a better understanding of what they can expect from visiting Copernicus in the educational context. The aim of the visit is not to generate a quantifiably greater understanding of specific subjects but to develop skills such as making observations, asking questions, conducting experiments, drawing conclusions, reasoning, honing soft skills and inspiring interest.

In 2019, workshops were attended by 120 teachers, mainly from Warsaw and its surrounds.

Pictured: *Measuring Man* exhibition

Temporary exhibition "Mind the Brain"!

As part of our research partnership with the **Human Brain Project**, Copernicus presented the exhibition **Mind the Brain!** created by the Bloomfield Science Museum Jerusalem. We spent three months evaluating exhibits, which addressed key issues stemming from our latest understanding of the working of the human brain, including how and why we study brains and who are the scientists working in the field. Our work contributed to improving the exhibition and making it more attractive ahead of its European tour.

The **Human Brain Project** (HBP) is a Europe-wide research programme, one of the two largest science projects financed by the EU. The HBP directly employs around 500 researchers at over 100 universities and research institutes across Europe. The aim of the programme is to develop state-of-the-art research infrastructure to support the development of the neurosciences, medicine and IT.

Temporary exhibition "Littered"

Burning landfill sites spewing toxic fumes into the atmosphere, collapsing mountains of rubbish, the great Pacific garbage patch, wild animals dying with their insides filled with plastic waste... All these are the direct result of consumerism: we buy stuff, use it, throw it away and buy more stuff. The festival exhibition **"Littered"** aimed to encourage visitors to take personal responsibility for the natural environment. The 250m^2 of exhibition space opened to visitors at our Pavilion 512 on the banks of the Vistula. Together with curator Marcin Szczelina, we talked about the world's largest landfill sites, waste processing in Poland, the dangers of plastics and air pollution, the scale of consumption of disposable products and the vast volumes of electrical waste generated each year. We also discussed ways of reducing food waste and segregation of rubbish, debunking several myths at the same time.

Biodiversity garden

We want Copernicus to be an example of good practice and an inspirational model of sustainable management of green spaces, therefore we have prepared plans to convert our Discovery Park into a Biodiversity Garden. The plans were devised during participatory workshops including experts in fields including phytosociology, ecohydrology, herpetology, ornithology and entomology, landscape designers, and representatives of the Capital Board of City Development, Public Road Administration, City Historic Preservation Office and employees of Copernicus.

The Discovery Park is currently covered with a lawn – an artificially-maintained monoculture which is sensitive to water shortages and does not provide a source food for insects or shelter for small animals. In contrast, the Biodiversity Garden will become a haven for nature. We will recreate natural plant habitats, study how native species are likely to cope with the changing climate, investigate solutions for retaining rainwater and work on improving biodiversity in this a small site in the centre of Warsaw.

Research shows that people in Poland have a low understanding of the significance of biodiversity and the consequences of species going extinct. They also aren't aware of ideas for adapting to the changing climate. As such, the development of the Biodiversity Garden is accompanied by a programme of educational activities aiming to improve public awareness of ecology, environmental protection and biodiversity.

Under development: Exhibition on challenges of the future

As part of our work to meet our strategic goal of providing top quality experiences for the million visitors we receive every year, we are preparing a new permanent exhibition exploring the challenges of the future.

Debates about the future include major concerns about the impending climate catastrophe, devastation of the environment and threats to biodiversity. At the same time, this is perhaps the first time in history that people are aware of and in agreement that the present generation must take responsibility and act to reverse humankind's negative impact on the environment on the global scale. The majority of tools helping us to reach this goal are provided by the development of science and technology, therefore ongoing progress is a major source of hope.

Pictured: *Littered* exhibition

The most important aims of our exhibition are to engage visitors in discussion, to ensure their experiences are authentic and to instill a sense of responsibility. We want the exhibition to provoke questions without necessarily providing all the answers. We want it to encourage visitors to think about the kind of future they want, the kind of society they want to live in and the kind of role they want to play in building it.

Work is ongoing on the first module of the exhibition, titled Civilisation of Algorithms. This part of the exhibition will be dedicated to digital technologies and their effect on our private and social lives. We are planning to launch the Civilisation of Algorithms in December 2020.

The exhibition about the challenges of the future and the accompanying educational programme will be implemented in partnership with Ministry of Digital Affairs and the National Research Institute – NASK Research and Academic Computer Network as part of the "Educational and information campaigns" project.

The participating parties signed a partnership agreement in November 2019.

In the works: "Hot-Cold" exhibition

Together with leading science centres Technorama in Switzerland and Phaeno in Germany, we have initiated the development of a temporary exhibition to be presented at each partnering institution. **We will be studying thermodynamic phenomena – changes in states of matter and thermal expansion, and also our perception of heat.** We want this to be an exhibition visitors can not only see, but also feel. The first exhibits are slated to be developed in 2020.

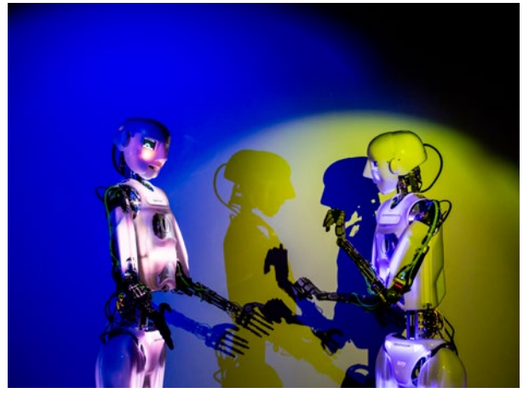
Robotics Theatre

In late 2017, Copernicus was visited by Tymek. Tymek was five-and-a-half years old, and his great dream was to see the Robotics Theatre. The youngster was hugely disappointed when he realised the theatre was temporarily closed, so he sent us a letter. He wrote: "Bring back the Robotics Theatre. Pease. Please. I want to see the show about Prince Ferrix and Princess Crystal. (...) I've been there, I want to work at Copernicus to build new electronic exhibits. (...) Please, let the Robotics Theatre live! Live! Please. I'm devastated. I'm trapped like a bird in a cage. (...) I don't care about anything apart from the Robotics Theatre, until you put it back into action. Please ask the director to allow a new Robotics Theatre (...) I just dictated this, my daddy wrote it down. I haven't learned to write yet. Bye-bye. Tymon." Robert Firmhofer, director of the Copernicus Science Centre, replied: "I was really moved by your letter and your disappointment when you couldn't see the Robotics Theatre. The RoboThespians are really tired after working on stage for many years, and they have gone off to a sanatorium to recuperate. (...) We will soon welcome brand-new robots, graduates from the British Theatre Academy. They will once again perform on the stage of the first ever Robotics Theatre at the Copernicus Science Centre. And I promise we will be bringing back the show about Prince Ferrix and Princess Crystal – it's one of my favourites, too. I sincerely hope you will come to see it."

The Robotics Theatre is a unique experience combining technology with art. The performances are played exclusively by robots; their unusual, intriguing format makes them extremely popular with kids and adults alike. We are developing our repertoire to tailor it to the expectations of viewers from different age groups.

Our flagship play **Prince Ferrix and Princess Crystal**, based on the writings of the world-famous sci-fi author Stanisław Lem, is presented in three languages: Polish, English and Russian. **The Secret of the Empty Drawer, or the Ghosts from the Fourth Dimension**, based on Edwin A. Abbott's 19th century novel "Flatland. A Romance of Many Dimensions", is a maths tale for middle school students. **What the Old Man Does is Always Right** (adapted from Hans Christian Andersen's classic fairytale) is aimed at the youngest visitors.

Samsung Electronics Polska Sp. z o.o. is the exclusive partner for the Robotic Theatre.



Pictured: *Prince Ferrix and Princess Crystal* at the *Robotics Theatre*

Part 3. Shows, workshops, meetings and laboratories

In order to meet our strategic goal of providing top quality experiences for our million visitors every year, we are constantly working on improving our operations and invite visitors to participate in dozens of activities which complement our exhibitions. Visitors can take part in miniworkshops, science shows and spectacles at the High Voltage Theatre and conduct short experiments presented by Copernicus on Wheels. Starting in March this year, visitors to the Copernicus Science Centre will also be able to meet experts, researchers, students and practitioners of science.

We want to help our visitors expand their curiosity and conduct experiments themselves, inspire them to ask questions and get involved in discussions with our staff about their time at the Copernicus Science Centre. We hope our activities provide our guests with meaningful experiences encouraging them to think about science long after they leave our walls.

Science shows

We want for visitors in the Exhibition space to interact first-hand with people who work in science for a living, with people fascinated with science. That is why our "explainers" lead various **science shows**, a majority of them at the High-Voltage Theater, and take **Copernicus on Wheels** around between the exhibits (our innovative form, midway between demonstrations and workshops). All these activities that go on within the Exhibit space strive to convey things in a light but content-rich form. While entertaining children and adults, we show a different way of looking at science: entertaining, artistic, spectacular. We tell interesting stories about science and scientists, while at the same time drawing visitors in. Shows also mean contact with a real-life person, conversation and interaction.

We also host short, informal workshops for small groups. Running for 15–20 minutes, **Miniworkshops** are the latest activities held in the exhibition space. The topics addressed are related to the themes of current exhibitions and allow participants to take a closer look at certain issues. The objective of the miniworkshop presenters is to bolster participants' curiosity and support them in their own investigations.

Visitors to the **Experimental Zone** were able to choose from miniworkshops on state-of-the-art energy technologies and on the secrets of the world of arthropods. At the **Measuring Man** exhibition, miniworkshop participants measured their lung capacity and built models of their lungs and diaphragms. During our After-Hours evenings for adults, visitors had a chance to learn more about codes and ciphers. Young visitors of **Buzzz!** learned what sinks and what floats, and explored the properties of air. During the Science Picnic, we presented miniworkshops on **Machine Senses**, explaining the workings of electronic sensors.

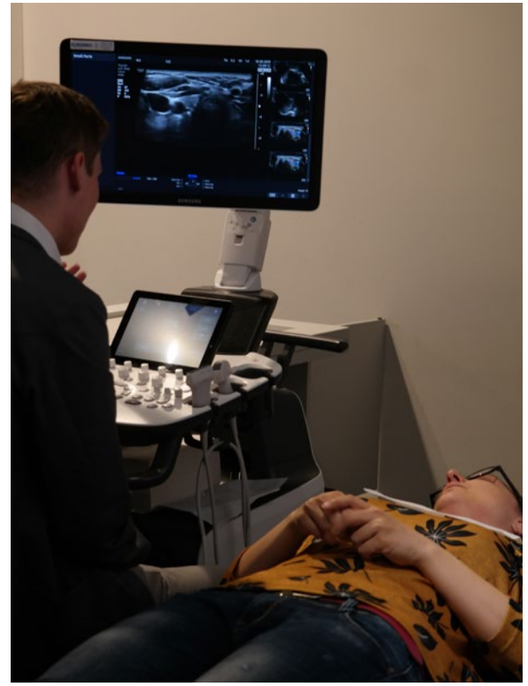
Every week, we host between 40 and 45 miniworkshop shifts; each shift lasts three hours and workshops run on a rolling basis – as soon as one group of participants finish, another group begins.

We also take our miniworkshops beyond our own walls: we have attended events such as the Science Picnic, the European Picnic and the anniversary of the Leonardo da Vinci Science Centre in Chęciny. Miniworkshops have also travelled abroad: last year we have taken them to China, Israel and South Korea.

We also travel with our science shows. In 2019, we were commissioned to develop **20 external shows**, which came to a total of 40 days and around **240 demonstrations**. We hosted eight shows onboard trains, and our most "in depth" demonstration was held 125 metres underground at the Wieliczka Salt Mine. We also travel abroad: in 2019 we visited Italy, Croatia, China, South Korea, Israel, Slovenia and Russia; in the latter we won a science demonstration competition, while our shows in Korea and China made a splash among the interpreters. After working at several presentations in a row, they started conducting the experiments themselves! Our team could return home safe in the knowledge they left their shows in the best possible hands.

Experts at Measuring Man

As well as Copernicus "explainers" who are passionate about science, visitors to the Exhibition Zone also have opportunities to meet experts in various fields and learn more about the work of young researchers. The **Measuring Man** exhibition hosted researchers, practitioners and students working in the field covered by the exhibition; in 2019 they were mostly medical professionals. Guests from the **Student and Junior Doctor Section of the Polish Ultrasound Society of the Collegium Medicum at the Nicolaus Copernicus University** and the Bydgoszcz branch of the **Student and Junior Doctor Section of the Polish Ultrasound Society** used equipment from Samsung to demonstrate the practical side of ultrasound examinations. Members of the **Student Association of Laboratory Diagnosticians at the Medical University of Warsaw** tested visitors' blood. Specialists from the **Mazowsze Branch of the National Health Fund** talked about tests offered by the Fund. Mateusz Banaszkiewicz, expert from the **Polish Association of Lifestyle Medicine**, explained how we can look after our mental health. Instructors from the **Great Orchestra of Christmas Charity** taught cardiopulmonary resuscitation (CPR) on adults, children and babies. Finally, experts from **Poltransplant** and the **Military Medical Institute** discussed transplant medicine and its legal, ethical and medical aspects.



Pictured: experts at the *Measuring Man* exhibition

Thinkatorium

The Thinkatorium is a part of the exhibition space where visitors can try their hand at tackling a range of construction challenges. The goal of the Thinkatorium is to encourage visitors to discover and understand natural phenomena by conducting experiments and engaging with the creative process. Participants are faced with a given problem and are provided the space and materials to investigate it, which they do independently by building, constructing and experimenting. By tackling engineering, scientific and logical challenges, they also hone skills essential in the 21st century: communication, collaboration, critical thinking and creative problem solving.

Some of the activities at the Thinkatorium, such as building bridges which can bear certain loads or constructing flying objects with given aerodynamic properties, generated vast amounts of waste, mainly plastic. Given that our core values focus on environmental protection, we are taking a closer look at the materials and tools used at the Thinkatorium. We aim to become more sustainable and to shift away from single-use plastic; our search for reusable materials has an educational slant, as well as making our activities more environmentally-friendly. Reusing materials stimulates creativity and inspiration for seeking new solutions.

The exclusive partner of the Thinkatorium is **Würth**.

Laboratories

Activities at our laboratories aim to meet two of our strategic goals: to provide top quality experiences for our million visitors every year, and to support learners in building knowledge through first-hand experience. Our laboratories are spaces for learning by the scientific method. Scenarios focus on fascinating latest technologies such as 3D printing, and focus on our everyday lives, recent scientific discoveries and major problems faced by humankind today, such as climate

change and rapid technological progress. Popularising this kind of learning is our mission at Copernicus.

Biology Lab

During sessions for school groups, students studied stimuli by investigating whether euglena respond to light by using the research method. Participants in individual weekend activities investigated climate change occurring all over the globe. The Biology Laboratory was visited by 3760 students as part of school groups and 4390 individual guests.

Chemistry Lab

School groups investigated the pH scale by experimenting with acids and alkali. Individual guests studied differences in ice density at different levels of salinity. The Chemistry Laboratory was visited by 3971 students as part of school groups and 6601 individual guests.

The exclusive partner of the Chemistry Lab is **BASF** Polska.

Physics Lab

Our visiting student groups faced a challenge to use the phenomenon of vibrations to construct scales able to weigh microscopic masses, for example that of bacteria or viruses. Individual visitors put themselves in the shoes of 19th-century inventors of light bulbs. The Physics Laboratory was visited by 3558 students as part of school groups, while the individual weekend sessions were attended by 4797 guests.

Robotics Workshop

Students learned the ins-and-outs of 3D printing and experimented on recyclable and biodegradable plastics. At weekends, individual guests constructed robots attracted by light. The Robotics Workshop was visited by 2894 students as part of school groups, while the individual weekend sessions were attended by 3081 guests.

The exclusive partner of our Robotics Workshop is **Raytheon**.

“After-Hours” evenings for adults. Hosted by Samsung.

After Hours evenings for adults are themed monthly meetings where we present serious discussions on science with a generous pinch of entertainment. Because they are open to adults only, there’s no need to compete with kids for access to exhibits. Each meeting has an overarching theme which we analyse during meetings with experts at workshops and lectures. In 2019, After Hours events were attended by around nine thousand people.

Issues discussed during the evening meetings complement other activities at Copernicus. For example, the **Interspace** event was linked with the Measuring Man exhibition (more on p. 14) and we discussed the human body. The **Machinarium** evening recalled the Science Picnic (more on p. 34), so we focused on machines, ties between culture and technology and phobias about technological progress. We also drove the Model S Tesla electric car right into the Copernicus Building. **Summer Awaits** included lectures about travelling and holiday flings, creative rest, car sharing and electromobility. We once again drove an electric car into the building, this time the BMW i3. October was dedicated to the Przemiany Festival (more on p. 32), so the After Hours events focused on themes of the event such as food and its impact on climate change, the carbon footprint and the facts and myths of healthy nutrition.

When we announced the October After Hours event on Facebook, revealing that we will be talking to a curator of fruit trees at the Institute of Horticulture about heritage apple varieties, we were inundated with comments. Almost a hundred web users joined in a discussion about the flavours and fragrances of pippins, russets and braeburns. We discovered that people love reminiscing about their favourite apples, and their memories stir positive emotions.

Pictured: *Machinarium* After Hours event for adults. Samsung Discovery

Family Workshops

Family workshops were weekend activities for kids aged between five and eight years old together with their parents and carers, complementing their experiences at Copernicus. The aim of the workshops was to help children develop their innate curiosity. We also wanted to show the attending adults how best to help guide their kids through the world of learning and how simple games and experiments can serve as a starting point for conversations about the world around us.

We will be discontinuing the Family Workshop format in the coming year. We want to replace them with activities held as part of the main Copernicus programme without the need to buy an additional ticket and make them available to wider audiences.

The exclusive partner of Family Workshops was **Polkomtel**, **operator of the Plus mobile network**, which also worked with us in 2019 on Making Contact workshops.

In 2019, we held 139 Family Workshops including 11 test events, eight workshops held as part of the Copernicus Club and three workshops for our partner the Plus network. The events were attended by a total of 3564 participants (children and their parents and carers).

Part 4. Planetarium

At the Planetarium we encourage our visitors to take an interest in science, in our planet and the universe. We showcase renowned scientists of the past and the present, thus meeting our strategic goals of participating in culture shaped by science and ensuring the highest quality experiences for our million guests every year. During **demonstrations** we talk about science: the cycle **Straight from the Sky** features discussions with scientists about the ins-and-outs of their work. We also host artistic events and concerts – and listening to music under the stars is an experience like no other! On top of that our presenters create live, improvised visuals on the dome – a true feast for the ears and eyes!

Pictured: a visitor wearing a home-made spacesuit, *Moon Village* as part of the celebrations of the 50th anniversary of the Apollo 11 Moon landing

50th anniversary of the Apollo 11 Moon landing

We celebrated the moon landing anniversary for five solid days! On 16 July we finally left the comfortable seats of the Planetarium to view the **total eclipse of the Moon**. Unfortunately we had to turn straight back inside, because heavy cloud cover made observations impossible. Once we were safely back indoors, our guests listened to talks about eclipses of the Moon and the Apollo 11 mission, as well as joining in with discussions with Dr. Grzegorz Brona, former director of the Polish Space Agency, and Ewelina Zambrzycka, journalist and author of a book describing humankind's exploration of space.

On 17 July, we kicked off a film marathon, with archival recordings from the Apollo 11 mission shown between screenings. Prof. Paweł Moskalik also talked about the Soviet Moon programme. The following day, we hosted a meeting with Dr. Agata Kołodziejczyk on past and present exploration of the Moon, held as part of the Straight from the Sky lecture cycle.

20 July passed under the banner of **Great Landing**, with a **Moon Village** standing in front of the Planetarium throughout the day. Young fans of astronautics launched rockets, developed their own spacesuits, studied Moon rocks and measured the distance between Earth and the Moon.

As part of our celebrations of International Children's Day, we suspended a replica moon in front of the Planetarium. The **artistic installation "Museum of the Moon" by Luke Jerram** was prepared jointly with BBC Earth. Our own moon, floating in the air and illuminating the night sky, was a seven-metre copy of Earth's satellite. The surface of the imitation moon was modelled on detailed NASA photographs on a scale of approx. 1:500,000 – this means that every square centimetre of the installation was equivalent to five square kilometres of the Silver Globe! Our moon created a magical atmosphere, brightening warm July evenings and attracting passers-by to listen to music under its glow.

New repertoire

The Planetarium is attended by guests from a wide range of backgrounds, with different needs and widely ranging interests in science; they visit alone or with kids. A large proportion of our audiences consists of school groups. Our challenge is to select a repertoire that meets the expectations of such a highly diverse audience while making sure we regularly update our programme and meet our strategic goals. Our repertoire features many new items.

Pictured: *Museum of the Moon*, art installation designed by Luke Jerram

We have been screening the film **Faster Than Light** since last February. It explains how we could one day reach planets beyond our Solar System. The audience traverse the Universe in a star ship fitted with antimatter engines and even a warp drive – just like in Star Trek!

In October, we added a brand-new, 50-minute-long film **Other Earths** revealing techniques used by astronomers to search for stars with planetary systems and identify Earth-like planets which might support life. The project was devised at the Planetarium with assistance from Prof. Aleksander Wolszczan, one of the first astronomers to discover extrasolar planets. Prepared between March and September, the presentation turned out to be particularly timely in November when the Nobel committee awarded astronomers James Peebles, Michael Mayor and Didier Queloz the prize in physics for their pioneering work on extrasolar planets.

We also presented **seasonal screenings**. In March we discussed the Hubble Space Telescope, in June we took the audience on a trip to the Moon with the Apollo 11 mission, and in October we viewed eclipses of the Sun.

Straight from the Sky

Held for the last few years, the cycle of meetings with scientists **Straight from the Sky** is the perfect opportunity to showcase their research and hear about their scientific achievements. Just 17 days after the publication of the first ever photo of a black hole, Copernicus welcomed **Dr. Maciej Wielgus**, member of the team of the **Event Horizon Telescope (EHT)**, one of the co-authors of the image. Dr. Wielgus revealed behind-the-scenes story of how the historic photograph was taken. **Inna Uwarowa** talked about the Polish satellite PW-Sat2, the **astrophysicist Dr. Romana Ratkiewicz** presented her lecture "Beyond the Heliosphere: Mission of the Voyagers", **Dr. Tomek Mrozek** from the **Laboratory for Polar System Physics at the PAS Space Research Centre** delivered his lecture "Awakening of the Sun", **Mikołaj Sabat** from the **Polish Society of Friends of Astronomy** talked about space cats, the **physicist Dr. Andrzej Dragan** discussed quantum theory and black holes, the **palaeontologist Prof. Marcin**

Pictured: display at the Planetarium

Machalski took the audience on a journey back in time to the days of dinosaurs, while **Dr. Agata Kołodziejczyk** from the **Analog Astronaut Training Center** talked about the Moon. The **astrophotographer Adam Jesionkiewicz** let us into some secrets of his profession, the **astronomer Prof. Andrzej Tadeusz Niedzielski** discussed exoplanets, the **geologist Dr. Wojciech Ozimkowski** talked about Mercury (the planet, not the liquid element nor the messenger of Greek gods, naturally), while **Dr. Sebastian Trojanowski** from the **National Centre for Nuclear Research** discussed the mysteries of dark matter.

The **EHT** consists of radio observatories or radio telescopes situated in many different locations around the globe. Many independent radio antennas, separated by hundreds or even thousands of miles, can be used to create a single virtual telescope with an effective diameter of our entire planet.

Concerts

Music sounds different when you're listening to it under a starry sky. In 2019, we held 54 concerts, including three New Year's Eve concerts (it's not that we celebrated the new year three times – we just held three concerts!), two Valentine's Day concerts, ten concerts for kids, four concerts as part of the Orbit of Jazz cycle, four Cosmic Live Electronic concerts, 30 concerts as part of the Concerts under the Stars cycle, and a special one-off Moon Concert marking the 50th anniversary of the Apollo 11 Moon landing.

Renovated Planetarium

It is easier for audiences to immerse themselves in the beauty of science and the universe when they are seated comfortably, so we have carried out extensive renovation and improvement works on our main auditorium. The original seats were worn out after over a decade of use, so we replaced them with new ones – the Planetarium chairs fold out flat to make it comfortable for the audience to observe the "sky". The auditorium is now better, more modern and more comfortable. The new chairs no longer have protruding levers, which it was previously easy to get tangled in. They are so comfortable viewers can be reluctant to leave them, although we do manage to go outside to observe the real night sky.

Perseids

When we emerged from under the Planetarium dome to view the Perseid shower, the sky was just as overcast as it was during the eclipse of the Moon. But we persevered! We switched off all nearby illuminations, put on some stellar music and warmed up the public by talking about the experience of observing the firmament while we waited for the clouds to clear. There were meetings with astronomers and workshops on meteorites hosted by our explainers... but, unfortunately, the much-awaited clear sky never came.

Part 5. Copernican Revolution Lab

Copernican Revolution Lab

The Copernican Revolution Lab is a key initiative of the Copernicus Science Centre that will help us pursue another of our strategic goals: creating knowledge, products and solutions that support learning processes and exploring the relationship between science and society. By building on the Copernicus Science Centre's experiences and seeking inspiration from the latest scientific and technological achievements, we are creating educational tools supporting the development of skills crucial for the 21st century. We pay particularly close attention to competences that underpin learning, such as critical thinking, creative problem solving, communication and collaboration. This is our answer to the challenges faced by education in Poland.

The Copernican Revolution Lab provides an environment for cooperation between researchers, educators, scientists, engineers, individuals promoting social engagement with science, and representatives of business and industry. The activities at the Lab are inspired by the principles of constructivist-based learning. The theoretical framework of our research is defined by interdisciplinary achievements of learning sciences. The methodological framework of our solutions draws upon the concepts of inquiry-based learning, problem-based learning and project-based learning.

Aims of our research and development programme, 2019–2021

1. To develop our understanding of learning processes at exhibitions and to help visitors build their awareness of learning through experimentation.

   Goals implemented as part of the project Science for You (more about the project on p. 27) and our collaboration with the SWPS University of Social Sciences and Humanities (more about the collaboration on p. 27)

2. To help students develop skills in conducting observations, asking questions and experimenting by providing educational kits for school.

   Goals implemented as part of the Summer Prototyping School (more on p. 27) and our work on the Air Module of the Modular Natural Science Labs (more on p. 26).

3. To develop skills in the creative use of technologies for problem solving.

   Goals implemented as part of our EduFactory (more on p. 28) and work using the educational robot Photon at schools (more about Photon on p. 28)

4. To support the positive influence of science on personal decisions made for the good of society.

   A survey on the future and its qualitative interpretations, conducted as part of the preparations for the tenth anniversary of the Copernicus Science Centre (more on p. 28).

5. To support the design of educational solutions such as kits and training sessions for teachers on the research method in creative processes.

   Work implemented in the form of scientific seminars organized together with the University of California, Berkeley, between September and December 2019 (more on p. 29) and during the Summer Prototyping School (more on p. 27)

Venue of the Copernican Revolution Lab

The Copernican Revolution Lab will be located in a brand-new building slated for construction next to the main building of the Copernicus Science Centre. Once erected, the building will become home to the activities we are already conducting as part of the Copernican Revolution Lab project. The building will host

an interdisciplinary R&D facility where research into learning science, psychology, sociology and education as well as natural sciences and technology will be conducted at state-of-the-art workshops, laboratories and co-working spaces.

Unfortunately, since the bids we received significantly exceed our construction budget, we were forced to annul the first tender for the project. We have since optimised the construction designs and budgets and launched activities to help us increase our own financial input and secure additional EU funds. In late 2019, we announced a new tender procedure organised by the Mazovian Unit for the Implementation of EU Programmes and invited general contractors to submit bids.

Modular Natural Science Labs

Modular Natural Science Labs (MNSL) are a project aiming to create tools to support teachers in conducting lessons using elements of the inquiry-based methods. Students attending such lessons conduct experiments while searching for answers to research questions they formulate themselves. Working with MNSL kits helps young people learn to pose research hypotheses, conduct observations and experiments, then draw their own conclusions. The kits constitute fully-ready didactic and methodological aids for primary schools used to meet curriculum targets in natural sciences including biology, geography, chemistry and physics. Primary school teachers and students have been working with the Water Module, distributed by the company Moje Bambino (a member of Copernican Revolution Lab consortium), since June 2018. The next kit, the Air Module, was released in July 2019.

The **Air Module** comprises 20 suggested experiments, together with all the required materials and methodology needed to conduct lessons based on the inquiry-based method. The Air Module helps students study phenomena such as corrosion, photosynthesis and convection. The included lesson plans must meet meticulous requirements:

- each scenario must take 45 minutes to complete (the duration of a single lesson);

Pictured: prototyping of an educational kit at the Modular Natural Science Labs

- each scenario must allow students to conduct experiments by themselves while meeting safety standards and ensuring teachers have full control over the entire process;
- all research questions must meet the curriculum targets;
- the tasks and experiments must be interesting and engaging in order to motivate students to complete them.

The main R&D goal during the development of the **Air Module** was to devise an educational process using the kit such that it could be implemented in all public schools in Poland. We were joined by 12 teachers who regularly work with Copernicus as experts and partners of the process. Kit prototypes were tested at schools.

Our work with teachers revealed that the greatest challenges lie in formulating accurate questions and interpreting experiment results. As such, every suggested lesson in the Air Module includes a set of questions which can be answered by conducting experiments. In order to make interpreting experimental results easier, we simplified the lesson plans such that each experiment includes a single variable which can be controlled. We also devised a five-point universal lesson plan adapted to meet the requirements, challenges and culture of Polish schools.

The MNSL project was initiated as a result of our collaboration with the Ministry of National Education and the Foundation for the Development of the Education System (which financed the Water Module). The exclusive licensee of the Air Module is the company Moje Bambino, Copernicus' partner.

R&D conducted as part of the Science for You project

We have developed the "Science for You" project to study learning processes at our exhibitions. One of the main goals of the project is to take our mobile exhibitions and planetarium to all corners of Poland (more on p. 37). The **Experiment!** exhibition including interactive exhibits for experimentation and discovering the laws of nature travels around on the **Educobus**. The **Planetobus**, in turn, carries a mobile planetarium for groups of twenty people. As in previous years, when the Educobus took exhibitions around the country, we conducted surveys among attendees. In 2019 we wanted to learn how moderating exhibitions visits influences emotions, how visitors use exhibits and how they perceive the educational value of inquiry-based learning. Our researchers organised tours following eight different scenarios (which adjusted the tasks given to teachers and students, added and removed instructions) and even provided lab coats. The latter were supposed to make students attending the exhibitions feel like real scientists.

The exhibition was best received by far by those students who visited it together with their teachers, serving as mentors and/or experimenting alongside their pupils. These groups reported the highest levels of positive emotions and the lowest levels of negative feelings. Respondents said they were drawn into the exhibitions and found them to be interesting and useful. A significantly less attractive and effective visit format involved one of the students taking on the role of the explainer. Such exhibitions visits were notably less well received than in the control group. We published detailed results in our report and tutorial "How to guide students through exhibitions".

Summer Prototyping School

The Summer Prototyping School (SPS), supported by funds from the Science for You programme, helps teachers transfer experiences working with exhibits to their everyday work at primary schools. Participants attend practical workshops held by tutors from research centres in the United States. During the week-long sessions, they develop teaching aids they would later use at their lessons. These aids are created following dialogue between teachers, employees of Copernicus and visiting partners who discuss methods and goals of teaching. All this means the SPS is a unique, practical seminar in methodology. The SPS is attended by finalists of the Science for You Competition, where they carry out the final preparations of their competition projects. For us at Copernicus, the School is the perfect opportunity to expand the circles of individuals involved in furthering primary education in Poland.

By working with teaching aids during school lessons, students develop their observation skills and learn to formulate questions and experiments. During the most recent session of the School, we used an old gramophone to construct a multifunctional exhibit demonstrating mathematical solids, light diffraction, internal reflection and many other phenomena. We are now considering building a similar exhibit for display at Copernicus. We can use the School sessions to prototype teaching aids with their future users and build relationships and ongoing R&D partnerships with creative teachers.

Partnership with the SWPS University of Social Sciences and Humanities

Together with the SWPS University of Social Sciences and Humanities, we held a grant competition for research projects which improve our understanding of learning through exhibits. The third competition is financed in equal parts by SWPS and the Copernicus Science Centre. In 2019, we concluded the research project "Individual differences in the transferability of knowledge gained during visits to the Copernicus Science Centre", led by Agata Kozłowska. The study

analysed cognitive mechanisms responsible for knowledge transfer by using analogies. Results of the study were presented during the Learning Adventures 2019 competition.

R&D work with the robot Photon

In 2019, we started studying how the educational robot Photon functions in schools. The project, due to conclude in 2020, will form the basis for recommendations of ways of introducing teaching coding in early learning.

R&D work at the EduFactory

The EduFactory is our educational fablab where kids, teenagers and educators learn according to the constructivist method by designing and building various objects.

We are working with fablabs, maker spaces and other similar organisations across Warsaw, networking among educational institutions focusing on construction, design, making and tinkering.

We also conduct our own R&D project here: hoping to learn which features of educational kits make them attractive to kids and their care-givers. We are investigating which ideas for using microcontrollers are favoured by younger teenagers, what helps them put these ideas into action and at which point they need support through videos or online instructions. We hope to create our own "first step with technologies" programme in 2020. We have also launched the EU project **Tinkering for Adults** as part of Erasmus+. The project is coordinated by the NEMO Science Centre in Amsterdam.

R&D at our labs

In 2019, working with the Hebrew **University of Jerusalem**, we started studying how spatial imagination develops at our Robotics Lab. The most spectacular activity of our labs in the past year was participating in the Przemiany Festival. Our resident biologist Stanisław Łoboziak and his team created the KitchenLab zone at the festival. Visitors took part in workshops with experts involved with protecting endangered varieties of apples and effective ways of storing food. The KitchenLab also showcased food of the future, such as edible algae enriched with high-energy fat and even **meat grown in vitro on spinach leaf scaffolding**. We found that it tasted rather bland, with a slightly salty aftertaste.

Tenth anniversary survey

As part of the celebrations of the tenth anniversary of the Copernicus Science Centre, we devised a survey on how people perceive the future, in particular social relationships, education, technology and environmental protection. The study was conducted using the nationwide Ariadna Online Panel in September 2019 on a sample N=1012 with an additional survey including people aged between 15 and 19 years old (N=400) and between 35 and 54 years old (N=521). The common element in the survey questions was how the respondents perceived the future in the context of climate change, social inequalities, professional success and the impact of AI and state-of-the-art technologies on our everyday lives. Following the panel survey, the Stocznia Foundation conducted a follow-up qualitative study. The aim was to construct interpreted data from nationwide surveys on lifestyles, education, science and the future conducted among representatives of different age groups. The results, their qualitative interpretations and data from additional surveys carried out in connection with the Educobus mobile exhibition will be the basis of the Copernicus Science Centre's vision and mission communication during our anniversary.

Learning Adventures conference

In 2019, we held the third biennial conference **Learning Adventures**. The event provides a space for academic reflection about learning at the intersection of formal and informal education. Learning Adventures is the perfect opportunity for researchers and creative practitioners to exchange knowledge and experience and to build relationships and networks. The theme of this year's festival was **Power(lessness) of Objects in STEM Discovery**. Through various lectures, seminars and discussions, we analysed the role of experiencing the world through our senses in learning and STEM education.

Pictured: creating food of the future, *Przemiany Festival 2019*

The conference brought together a hundred-odd scholars, designers of teaching aids and educators. We were inspired by the presentations of special guests Prof. Manu Kapur (ETH Zurich) and Prof. Ricardo Nemirovski (Manchester Metropolitan University). **Our hearts were captivated by five teachers – Dominik Burchard, Piotr Fąka, Michał Gładki, Barbara Szymańska i Barbara Zagrodnik – who were commended as part of the Science for You competition for developing their own teaching aids.** Their stories about the importance of teaching aids painted a fascinating picture of the kind of teaching we would all love to experience ourselves.

The partner of this year's festival was the SWPS University of Social Sciences and Humanities and the New York Hall of Science.

Scientific conferences

We present the results of our research into learning processes through publications and conference presentations. At academic conferences, members of our research teams made presentations on the following subjects: **Co-creation process in designing educational tools: role of designers, museum experts, and teachers in building a common understanding of education goals and values** (International Symposium of Science Museums, Daejeon, South Korea), **Epistemic practices in museum settings: exhibits, exploration, embodiment** (The Future of Embodied Design for Mathematical Imagination and Cognition (EMIC), UW-Madison, USA), and **Are Visitors Learning?** (Preconference, ECSITE).

Seminar with Prof. Abrahamson

The Copernicus Science Centre's team has been expanding its horizons at a rapid rate. During the first six months of 2019, we completed our marathon read of the vast tome titled Learning Sciences. Every week, small groups of participants discussed successive chapters of the six hundred-page textbook. This served as excellent preparation for our great intellectual adventure: a seminar about learning processes hosted by Prof. Dor Abrahamson from the University of California, Berkeley, and his doctoral students.

On eight consecutive Tuesdays, 12 people from four departments of Copernicus were joined by the Berkeley team between 6pm and 8pm to analyse and interpret video footage recorded at our exhibitions. All this hard work had concrete results: three conference papers and four joint publications! In 2020, we are planning to apply for grants to continue our seminars with Prof. Abrahamson.

The seminar was as special for our partners from Berkeley as it was for us, as stressed by Prof. Abrahamson in his letter to us:

Dear Załoga,

(...)

Your work is very important to the field of the Learning Sciences. When you agonize over how best to formulate a research question, you are entering the practice of Learning Sciences research. In so doing, you are creating opportunities for dialogue between practitioners and scholars. You are building bridges, partnerships, synergies. This is what educational research is all about. We are making CNK into Europe's lab museum, and, for that to happen, it is imperative that CNK people are conversant partners for future interactions with resident and visiting researchers. There is a greater good at stake.

(...)

It has been an honor and delight to work with all of you. You have given us, here at Berkeley, much food for thought. You have challenged us to be clearer. You have articulated pivotal questions that will drive much inquiry, moving forward. Congratulations on the milestone of submitting work for publication at ICLS. There is nothing as exacting and as rewarding than facing the review process. It, too, should be regarded as part of the dialogic growth that we have witnessed in Załowaga-CReW. I am convinced that this is just the beginning.

(...)

Yours,

Dor

Samsung Electronics Polska Sp. z o.o. is the main partner for the Copernican Revolution Lab.

Saint-Gobain Innovative Materials Polska Sp. z o.o. is our investment partner for the Copernican Revolution Lab.

Part 6. Scientific Events

The common denominator of all events held at Copernicus is science. But we don't put science on a pedestal: instead we treat it as a part of culture which unites us as a society. We don't carve it up into distinct fields and we don't artificially separate it from all other topics people are interested in. Rather, we show how closely it is intertwined with our daily lives and challenges we face as a society. This perspective is our inspiration and encourages us to take up bold subjects which we pursue beyond the walls of Copernicus.

We constantly search for new formats for our activities to meet the needs of different groups of visitors – and we want them all to become active participants in science. We want everyone to understand how scientific research is conducted, what it involves and the significance of its results for the future of humankind.

We create opportunities for people to exchange opinions, learn from one another and to work together. Sometimes it's simply a matter of spending time together having fun and enjoying intellectual adventures. The majority of our events are free and they are a perfect complement to our regular offerings.

FameLab competition

FameLab is all about science communication – about presenting complex subjects in a clear, concise way. Scientists taking part in FameLab are experts at making science comprehensible and captivating. And it's no easy task! Once they step up to the microphone, the participants have three minutes to explain a given topic with clarity, expertise and charisma. In 2019, finalists were cheered on by a 300-strong audience, and the online stream was viewed 1357 times. The winner was Asst. Prof. Ewelina Sielska-Badurek – a doctor of medicine, phoniatrist, singer and populariser of science. She talked to the FameLab audience about medical conditions which might affect how someone sings.

Ig Nobel Prize

Copernicus has hosted Nobel laureates several times in the past. The most recent time was last April Fools' Day, except this time we welcomed the founder of the Ig Nobel Prizes and one of the winners. We heard lectures from Marc Abrahams, founder of the Annals of Improbable Research and originator of the award, and Kees Moeliker, winner of the 2003 Ig Nobel prize for biology for his research into homosexual necrophilia in male mallard ducks. Moeliker is also director of the Natural History Museum in Rotterdam where he has observed birds which died after crashing into the building's glazed walls. During his lecture, he discussed animal behaviour and Warsaw architecture, noting the city's buildings which are most lethal for birds.

Tesla Day

One of our goals is to showcase famous scientists with the hope of encouraging young people to follow an academic career path. It wasn't that long ago that not many people had heard of Nikola Tesla outside the realm of scientists, experts in the field and historians. Today Tesla is ubiquitous in popular culture as a protagonist of books and movies, not to mention the car brand. Our event commemorates the inventor and his great contributions to science, and describes the fascinating phenomenon of electricity. On Tesla Day, we were visited by 3223 guests. They enjoyed the High Voltage Theatre exploring the nature of electrical current and gasped at the **BMW i3 electric car** we drove right into the Copernicus building.

Innogy Polska is the exclusive partner for Tesla Day.

Museum Night

On certain selected days, we open the doors of Copernicus between 8pm and 2am. This year we were seriously worried if we would get any visitors at all, since it had rained all day long. When the time came to throw open our gates... the rain stopped and we saw the legendary queue of visitors forming, waiting to

attend our Exhibitions and Planetarium. **Copernicus on Wheels** weaved its way along the line, while explainers held demonstrations including "Pressure", with one of our most popular experiments involving upturning a glass filled with water over a volunteer's head. The trick always works, except... this time it didn't. The volunteer got drenched, with the whole event preserved for posterity by a slow-motion camera recording the demonstration. Luckily for all involved, the evening was warm and the glass small. The video has been secured and archived. As the final guests left at 2am, we counted 6163 visitors over the course of the evening. And, as we closed our doors, the skies opened once again.

Appetite and Apathy, or the 9th Przemiany Festival

At Przemiany we look to the future: we consider how human activity (or inactivity) is likely to change the world and what kind of reality we can expect to leave to future generations. This year we focused on the problems of food production and nutrition around the globe. At the inaugural lecture, Dr. Koert van Mensvoort talked about speculative scenarios of the future of food, for example laboratory-grown meat. Dr. van Mensvoort is the author of *The In Vitro Meat Cookbook*. A copy of the book was to be given away as a prize for best question asked after the lecture, but there were so many questions the author couldn't choose one. Instead, he decided to give the book to the youngest member of the audience: baby Jagoda snoozing in her mum's arms. In his dedication, Dr. van Mensvoort wrote: "I hope one day you'll be able to taste some of the dishes from my book!"

But why food of the future in the first place? In the early decades of the 21st century, *Homo sapiens* has reached a point critical for the future of our planet. One of the key problems of our continuing existence is finding sufficient sources of food for all. And unless those sources are sustainable, we are going to struggle to prevent a climate catastrophe and halt the progressing destruction of the environment.

At Przemiany 2019, we created a platform for a creative and engaging exchange of ideas in a diverse, interdisciplinary environment. We welcomed 44 experts in science, art, technology, design, business, the media and cookery. Przemiany was visited by around 4,500 guests. We explored scientific and technological innovations and effective campaigns and businesses, rooted in extensive research, leading to a positive shift in how we think about food and nutrition in the context of our wellbeing and protecting the environment. Discussions focused on specific examples considering potential future scenarios. We hope that these discussions helped participants to gain an understanding of the process of transforming the entire food supply system. As a results, visitors to Przemiany gained essential knowledge of the subject and learned where to search for scientific and technological solutions and how they can themselves get involved in activities which best meet their interests and values.

As well as academics, each panel of experts included individuals representing activist, business and legal circles. We wanted to minimise the risk of our discussions becoming excessively academic and thus less accessible to the general public. This is especially important given the growing distrust in science among the public, with certain groups questioning verified scientific and research achievements and reliable predictions of the future.

Grants awarded at Przemiany U19

Participants in **Przemiany U19** – the festival section aimed at young people – received minor funding to help us look at how problems in the food production field can be solved at a small scale and at low cost. If young people can create composters, systems monitoring insect populations or 3D printers using just a few thousand zlotys, then adults with significantly greater funds at their disposal should be able to achieve far more, and in fact they could find inspiration in young people's activities (and even be put to shame by them).

Festival exhibition Lulled by Satiety

Basse Stittgen exhibit "Blood Related" explores one of the side products of the meat industry. The artist uses freeze-dried blood as a material to create objects such as plates. He also made an blood "vinyl" record with a recording of a cow's heartbeat. One of our visitors found herself unable to step away from the exhibit, and she wept as she listened.

Pictured: chicken meat grown *in vitro* on a spinach leaf, *Przemiany Festival 2019*

"Blood Related" and other exhibits confronted visitors with facts about the global production, distribution and waste of food. Waste generated by the food industry and consumers is equivalent to tonnes of unused, spoiled food thrown away and rotting at landfill sites all over the planet – our planet where many huge societies have no access to sufficient, safe food. The exhibition aimed to encourage visitors to take responsibility for the future of the world. Science and technology are constantly coming up with new ideas and possibilities, but it is us who must make the effort to change our attitudes and abandon convenient yet wasteful habits; after all, the future of life on Earth depends on finding new ways of producing food for us all. We explored alternative sources of protein: algae, insects, plant extract and **meat cells grown on leaf scaffolds** which have never been part of a living animal, made at our own labs. The visitors conducted experiments with foods of the future: yeasts, bacteria, algae and *in vitro* plant cultures.

Selected activity formats of Przemiany 2019

Common Table: We invited the public and experts to sit down at a single table to bring them closer together and facilitate discussion.

Myths and Memes: We trialled an innovative combination of a lecture and discussion analysing scientific myths and the creation of memes which make scientific communication easier.

Good Chemistry: Influencers and Scientists: We brought people whose heads are full of facts but who can't always reach the right audiences together with people who have vast audiences but don't always know where to find facts. The experimental discussion-panel formula allowed us to uncover conflicts between communicating and popularising accurate scientific knowledge and shaping, describing and promoting culinary and lifestyle trends. The meeting was followed at a later date by workshops bringing together scientists and influencers, held during the 2nd SCIENCE AND THE MEDIA Congress at Copernicus.

Food of the Future: The discussion panel included a tasting of snacks made of unusual ingredients, such as flour made of crickets.

How Can We Eat Without Destroying Our Planet? The screening of the documentary "Soyalism" was followed by a panel session where we discussed topics from the film with experts.

Postapocalyptic Pils: We sampled the Przemiany beer, created especially for the festival by the Inne Beczki brewery and sold at the festival cafeteria. The ingredients are metaphors for the problems facing food supply at the brink of a climate catastrophe: rainwater (because it may soon be the only available), maize grits (because malt is an essential component of beer) and wild hops (because cultivated varieties could one day go extinct).

Concerts: Each day closed with a gig, helping our visitors settle after a day of emotion-filled discussions.

In vitro Meat: At our Biology Lab, our resident biologist Stanisław Łoboziak grew chicken meat cells on scaffolding taken from a spinach leaf. We all sampled the meat, and we all survived.

The 2019 Przemiany Festival "Appetite and Apathy" was co-financed as part of the BLOOM EU project and the British Council.

The Science Picnic of Polish Radio and the Copernicus Science Centre

The Picnic is an embodiment of our strategic goal of increasing participation in culture shaped by science. The Picnic is a direct, face-to-face encounter with science. It is a day filled with experiments and research. The aim of the Picnic is to help participants get to know and understand science; to meet and get to know scientists, see how they work and talk to them. And it is these discussions which are the most valuable for both sides: they help visitors gain an understanding of science, and they allow scientists to find out other people's views, expectations, hopes and fears of science.

This year's Picnic, held under the banner "Machines and Us", focused on progressing automation and questions about the future in which humans and robots coexist. At the Picnic, we explored the incredible abilities of machines, such as robotic limbs and robots helping scientists with difficult and dangerous laboratory work. Visitors built and programmed robots, drove remote controlled vehicles and admired a mobile model of a tank built following Leonardo da Vinci's designs.

Science Picnic 2019 in numbers:

- approx. 200 scientific institutions, universities, museums, cultural institutions and science clubs;
- approx. 1,000 demonstrations and experiments;
- approx. 50,000 visitors
- 215 tents;
- two large halls and 22 discrete stands at the stadium Gallery;
- equipment delivered by seven HGVs;
- 700 metres of temporary fencing;
- 448 benches;
- 698 tables;
- 1860 chairs;
- 1206 electrical sockets;
- 1237 kW of electricity.

Changes

To make it easier for our visitors to find their way around, we reorganised the entire Picnic space, introduced thematic zones and moved panel meetings to the stage. The new arrangement helped visitors orient themselves and move among stands covering similar topics. Surveys conducted among visitors to this year's Picnic show that the zone-division strategy brought the desired effect and was welcomed by guests. The **Future Zone** where visitors pondered the world ahead of them and considered the degree to which machines will soon take over received the highest scores. The **Health Zone** was also popular, where visitors explored state-of-the-art technologies used in medicine. The **Must-see experiments Zone** was the epitome of the Science Picnic, presenting everyone's favourite experiments: colourful chemical reactions, generating electricity from fruit and vegetables and unusual musical instruments. The **Family Zone** featured demonstrations and games tailored to the skills, understanding and perception of the youngest guests. The **Do-It-Yourself Zone** was a paradise for tinkerers, where they constructed ingenious devices under the eye of experts. In the **Civilisation Zone**, visitors analysed the role played by machines in the technological development of humankind. Finally, the **International Zone** was filled with stands of exhibitors from abroad: research institutes, schools, diplomatic outposts and organisations specialising in scientific demonstrations.

Pictured: *Science Picnic of Polish Radio and the Copernicus Science Centre 2019*

Return of the Stage

After an absence of a few years, the Picnic has brought back the stage, which we placed right by the stadium pitch. It was used to hold demonstrations, science shows and panel meetings. During the very first panel, however, our collective jaws dropped when we saw ten lorries full of gravel driving onto the pitch. It turned out that the surface was being prepared for speedway racing. We had no choice but to carry on with our demonstrations with lorries in the background. This turned the Picnic's motto "Machines and Us" into reality. As we were trying to promote science, machines kept delivering more gravel. Things finally fell silent before the last panel. The speedway track was ready. Yet as soon as the discussion started, a huge tractor towing sprinklers appeared. The machine finished work at the precise moment when we thanked our audience for attending. A truly incredible symbiosis of humans and machines. The next Picnic will be held under the banner "Climate and Us", and we are already wondering what might appear behind us on the pitch!

The panel on science as a way of life featured a discussion between astronomer Jakub Bochiński, science journalist Karolina Głowacka and cultural anthropologist Marcin Napiórkowki. As well as debates and scientific demonstrations, the stage also hosted meetings with YouTubers promoting science to young viewers: Katarzyna Gandor, Piotr Kosek, Huyen Pham and Bartłomiej Szczęśniak talked about the role of the internet in popularising science, subscriber expectations and myriad pitfalls of trying to discuss serious science in an entertaining way.

The Picnic as reflected in surveys conducted by the Centre for Public Opinion Research[4]

Picnic 2019 attracted over 50,000 visitors

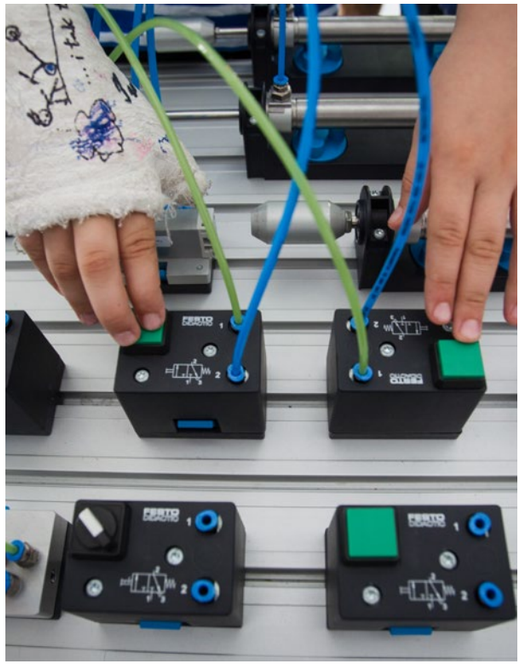
- over half the visitors attended the Picnic for the first time;
- three-quarters of the visitors came from Warsaw and its surroundings;
- over three-quarters of the visitors also regularly attend the Copernicus Science Centre.

Who attends the Science Picnic

Picnickers represent all age groups. We see school students wondering what to study at university – some even make a decision on their future at the Picnic. Many visitors have completed their formal education, but they want to keep expanding their knowledge. The Science Picnic is very much a family event. Over 40% of the visitors are children under 15 years old, and over half are under 18.

Why attend the Science Picnic?

The vast majority of respondents indicated specific aims for their visit; over a half stated that they were "searching for something interesting and something to think about", while over a third were motivated by hoping to get their children interested in science. Almost a quarter of visitors aged 24 and below stated that they came to the Picnic to improve their understanding of a particular scientific field. Half of all respondents replied that the Picnic is "simply a fun way of spending free time". 2.6% of visitors attended the Picnic by chance. Almost two-thirds spent more than two hours at the Picnic.



Pictured: *Us and Machines* or the future of robotics, *Science Picnic of Polish Radio and the Copernicus Science Centre 2019*

The survey clearly shows that parents attending the Picnic see their children's education as very important: almost 90% of parents of preschool and school-aged kids enrol them in extracurricular activities.

The Science Picnic of Polish Radio and the Copernicus Science Centre is supported by the Capital City of Warsaw, the Ministry of Science and Higher Education and the PGE Narodowy Stadium.

4 The full survey report is available on the Copernicus Science Centre's website.

Part 7. Educational programmes and projects

Following our strategic goal of supporting learners in constructing knowledge based on their own experience, our Education Lab develops, makes and disseminates educational aids. We work with teachers, educators, scientists, researchers and non-governmental institutions. We want to accompany young people along their journey in developing their interests and skills in science and technology. Our activities help shape attitudes and skills which are key in the contemporary world: critical thinking, creative problem solving and teamwork.

Our educational formats are founded in the ideas of constructivist learning and apply the inquiry-based method, helping users discover the world for themselves by posing research questions, then testing them by constructing, experimenting and observing.

The Educational Lab implements nationwide and international programmes and projects, such as the Young Explorer's Clubs, the ESERO educational arm of the European Space Agency, Dream Designers, and Modular Natural Science Labs. We support educational communities in using new tools and methods and we build collaboration networks between educators and partners. We create space for sharing information and experience, and for holding discussions on the future of education.

Science for You project

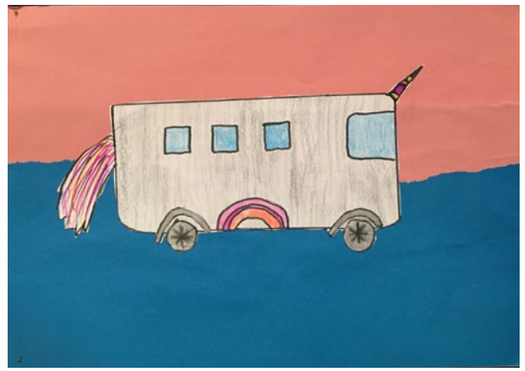
We held the Science for You project for the third time. The aims of the project, implemented jointly with the Ministry of Science and Higher Education, are to encourage children's cognitive curiosity, to help teachers expand their understanding of working with the inquiry-based method, to improve skills at making educational aids and to build a positive image of science. During the last year, we significantly expanded the project formula, helping us reach out to wider audiences.

Can't come to Copernicus? Copernicus will come to you!

The Science for You programme relies on the **Educobus** travelling exhibitions and **Planetobus** mobile planetarium. **The Experiment! exhibition, comprising interactive exhibits for conducting experiments and discovering the laws of nature, travels on the Educobus.** Our visits are major events in local communities; they frequently attract members of local authorities and are covered by the local press. Students conduct experiments during school hours, and later in the afternoons, once the exhibition is open to everyone, they come back to spend time there with other generations of their families.

Sometimes the Educobus arrives with a real bang: at one school, the headmistress decided to demolish a wall at the gym to make room for our exhibits! In 2019, the Educobus made 115 trips and its exhibitions hosted 66,739 people. **The Planetobus carries a mobile planetarium**, where we host astronomical displays projecting the current map of the night sky on the dome. In the evenings, we supply telescopes and binoculars to our guests to observe the stars. In 2019, the Planetobus made 62 trips with a total of 22,210 participants.

The Educobus and Planetobus visit schools and cultural centres at towns with populations under 130,000 people in almost all corners of Poland. We also attend major events. Last year, the Educobus visited the **Long**



Pictured: drawing titled *Science Unicorn*, presented by students to the Educobus team

Night of Sciences in Berlin. In collaboration with the Polish Institute in Vilnius, the Planetobus travelled to **Lithuania**. We also attended the **Museum Night at the Ministry of Science and Higher Education**, the **Children's Day Picnic at the Chancellery of the Prime Minister** and the **Chancellery of the Prime Minister and Congress of Science**.

Science for You competition

This competition is for primary school students and their teachers from all over the country. In 2019, the competition attracted almost 900 kids and 180 adults. The competing teams who designed and built their own educational aids were whittled down to ten finalist teams, whose representatives take part in the Summer Prototyping School (more on p. 27). The jury then selects the five most interesting projects, and the winning teams are crowned as victors of the competition. The schools attended by the finalists and winners are also awarded prizes. The grand gala closing the competition brings together the full winning teams plus representatives of those that were shortlisted. The most recent gala was attended by 280 people; as well as competition participants, we also welcomed representatives of the Ministry of Science and the Copernicus Science Centre. Projects awarded at the competition were displayed in our Exhibition space.

Winning projects included:

Solidrotation – a device illustrating physical phenomena such as optical illusions, rotating figures and the centrifugal force;

Don't Hesitate – a machine visualising vibrations and sounds using Lissajou curves;

Cyclospin – a multifunctional educational aid illustrating the Coriolis force, visualising optical illusions and teaching the basics of mechanics.

Science for You online

In order to help teachers teach using inquiry-based method, we hosted ten webinars led by Copernicus experts. Participants were able to ask questions and comment on the proceedings in real time. The courses covered subjects such as using the scientific method in schools, working with educational aids and the role of teachers in using educational exhibitions. We posted recorded materials from the webinars on YouTube.

We also designed a website, using responsive web design, containing instructions for a wide range of experiments. Users pick objects they happen to have on hand from a list, and the algorithm suggests experiments they can conduct using those items.

The Science for You project also includes an R&D component. **More information on the Summer Prototyping School and R&D conducted as part of the Science for You project can be found in Part 3: Research & development**.

The joint Programme of the Minister of Science and Higher Education and the Copernicus Science Centre, named "Science for You", is financed by the Ministry of Science and Higher Education according to the contract form 4 January 2019, no. 1/CNK-NAUKOBUS/2019. The "Science for You" Programme covers the activities of the "Educobus" and the "Planetobus".

Schools Closer to Science

The project **Schools Closer to Science (SCS)** was the practical outcome of our strategic goal of supporting learners in constructing knowledge based on their own experience. Project goals of the SCS, implemented over the two years of the project, were **improving teachers' professional skills, providing additional equipment to school laboratories to support the use of the inquiry-based methods, and developing students' skills in natural sciences through activities such as educational and research projects conducted with scientists**. For example, students from Lesznowola worked on the **M3 for Bees** project. One of the activities involved placing special insect "hotels" to attract bees. Unknown to the participating kids, the project also included their parents, who aided nature by providing store-bought bees' colonies near the hotels. This gave the M3 for Bees project added value by engaging parents in their children's education, which is a well-known motivational factor.

Pictured: finals of the *Schools Closer to Science* project at Primary School no. 6 in Otwock

Student Research Projects culminated the two-year cycle of meetings and workshops introducing new teaching methods, inviting students to attend exhibitions at Copernicus, hosting sessions at the Thinkatorium and our labs and presenting extracurricular lessons for project work, including IT lessons and fieldwork using the MNSL Water Module (more on Modular Natural Science Labs on p. 26). Schools participating in the project also received laboratory equipment, funded by their governing bodies.

The research projects are in themselves pioneering activities, engaging scientists in work carried out by participating students and schools. Experiencing the entire research cycle as part of the project helps participants learn to conduct research independently, plan experiments, collect results, draw conclusions, write summaries and work as part of a team.

Surveys monitoring the project revealed that the Schools Closer to Science project helped teachers develop their skills in using active methods and the inquiry-based methods, finding and developing educational aids, planning lessons including elements of informal education, running small group sessions and working using research projects of their students. Students improved their skills in planning and carrying out experiments, conducting observations of natural phenomena, using various teaching aids, working as part of a team and using their results to draw conclusions.

According to the survey, students' abilities to find information from different sources and analyse data using IT tools did not improve following the project. However, this is potentially because the students were already highly skilled at these tasks, and the students unanimously stated that they already have these skills.

We also hope that the SCS project will help us **develop relationships with local communities** and **build communities whose goal is to develop and improve education**. Following the SCS project, five schools created **Interschool Natural Science Labs** (fully equipped laboratories and workshops for students and teachers from other schools) and 11 new YECs (more on p. 40). The project engaged local authorities, school heads and teachers who worked together on developing key competences essential in today's world:

teamwork, creative problem solving and using new technologies in education. As shown by the example of bees from Lesznowola, the project also taught teamwork and creative problem solving in spheres we weren't even expecting.

Scientists leading research projects as part of SCS:

- **Magdalena Osial** (chemist): the "Corrosion" project studies the influence of external factors on metal strength and the effect of corrosion products on plant growth;
- **Dariusz Aksamit** (medical physicist): the project "Radon: Measure This" explores natural radioactivity and involves developing a system of radon detectors to be used in the home, school etc.;
- **Barbara Pietrzak** (ecologist and evolutionary biologist): the project "Environments Shape Animals" explores how environmental conditions, such as the presence of predators, affect the behaviour of water fleas (*Daphnia*);
- **Marcin Grabowski** (entomologist): the project "M3 for Bees" studies insects and tests different types of insect hives with the aim of encouraging pollinators.

Project partners

Copernicus Science Centre
Capital City of Warsaw
Grodzisk Mazowiecki commune
City of Otwock
City of Żyrardów
City of Kobyłka
Lesznowola commune
Stare Babice commune

The "Schools Closer to Science project brings together seven communes of the Warsaw region to create optimal conditions for teaching based on the experimental method by improving the skills and competences of teachers in using experiments in lessons, equipping schools with educational kits and tools for teaching natural sciences, and developing students' skills in natural science by conducting educational and research projects" is financed by the European Social Fund, Priority Axis 10, "Education for regional development", Activities 10.1 "General and preschool education", Subactivities 10.1.2 "General education as part of the ITI Regional Operational Programme of the Mazovian Voivodeship 2014-2020. Total value of the project: 4,999,821.65 PLN. Funds of 4,733,416.65 PLN comprise 94.67% of the project, including: European Social Fund 3,999,857.32 PLN, national budget 733,559.33 PLN

International Young Explorer's Club programme

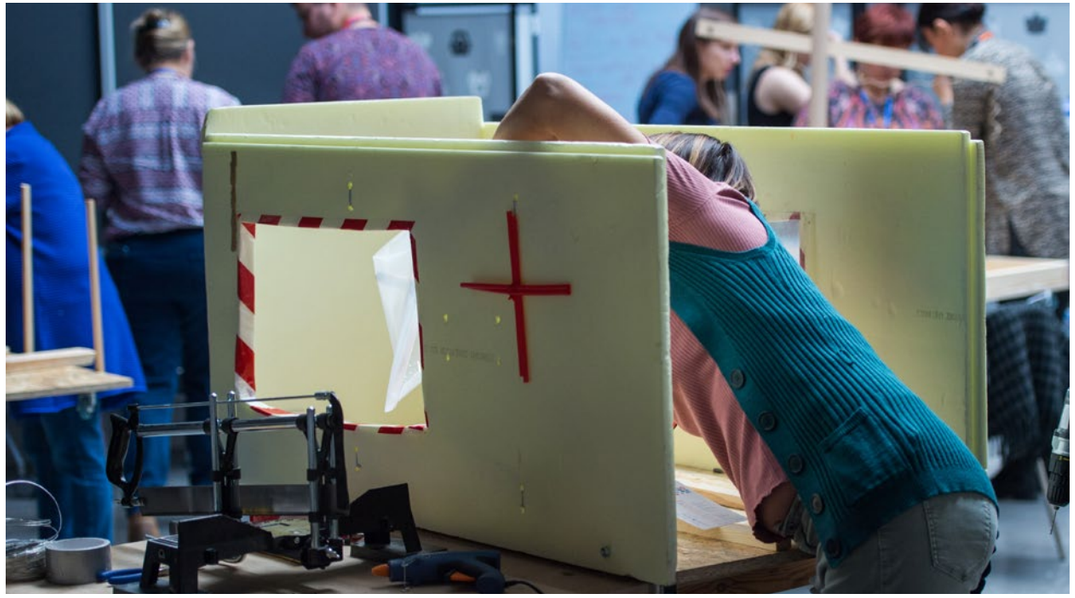
Conducted in tandem with the programme's strategic partner, **the Polish-American Freedom Foundation** which funds some of their activities, Young Explorer's Clubs (YEC) are one of our most important endeavours. By supporting networks of YEC partners and their local educational circles and promoting learning through research and construction, we are meeting our strategic goal of **supporting learners in constructing knowledge based on their own experience**.

The YEC programme is the embodiment of the mission and vision of the Copernicus Science Centre. We build collaborative networks focused on science and its challenges and rooted in openness and honesty. We inspire club members and their leaders to conduct experiments to help them gain a better understanding of the world around them. The programme aims to shape attitudes encouraging young people to act responsibly to create a better world. It's an ambitious challenge, but we ourselves are ambitious.

How it works

The most important value of the programme is freedom. Club leaders are completely free to plan their activities, decide how often their club meets and select topics to study. What happens at each session is up to club leaders and members. And this freedom results from trust in club leaders who, by knowing their club members, are best placed to make the most of their interests and abilities, and in regional coordinators who, by knowing local conditions and requirements, are best placed to support club leaders and members.

Clubs exist thanks to the engagement of their leaders who support club members in developing a passion for discovering the world through science. **Each club has such a mentor**. At clubs for preschool children, leaders run sessions. At clubs for older kids and teenagers, the mentors leave the initiative to club members and help and support them as and when necessary. YEC mentors – teachers, librarians and employees of cultural centres – are active, engaged individuals who are highly experienced in their work and are always on the lookout for new challenges. They lead clubs on a daily basis, and they get involved in many other



Pictured: *YEC Forum 2019*

educational projects with their students. Fans of astronomy take part in ESERO projects and expert tinkerers apply for grants for Dream Designers; we meet YEC leaders at the Lay Out, Let Out conference, and ever since the first edition of the Science for You competition, teams led by YEC leaders have been regular winners. Partners, leaders and members of YEC use support networks to exchange experiment ideas, share good practice from ongoing and completed projects, discuss their work and inspire one another.

Club mentors also get their local communities involved and influence education in the region. For example, a club leader from Chełmno founded a network of clubs at preschools, and now most kindergartens in the city host regular classes for kids. In Silesia, as a result of the collaboration with the nationwide partner German-Polish Youth Office, YEC leaders took part in a school exchange programme between the countries. They also organise conferences for educators and science picnics at the Silesian Intercollegiate Centre for Education and Interdisciplinary Research, branch of the University of Silesia. In the Podkarpackie Voivodeship, YEC support the development of a science centre in Jasionów near Rzeszów.

Children and teenagers attending YEC work using the inquiry-based methods: they formulate questions, conduct experiments and observations and draw conclusions. They choose their own research topics. The supportive atmosphere of the clubs helps children gain confidence, learn to perform in public, defend their opinion and hold debates. The programme operates throughout Poland and beyond its borders, at all levels of education and in all fields of knowledge.

Structure of YEC

The international YEC programme is hugely popular; it continues growing, and it is starting to reach the point we are no longer able to coordinate the increasing number of clubs. At the end of 2019, our database included **700 clubs in Poland** and **160 in Georgia**. Our aim is to change the organisational structure of the programme so that the main burden of activities falls to autonomic, highly skilled regional partners. Our **regional partners** organise activities encouraging educators to found new clubs, refine their skills as club leaders, improve ways for clubs to collaborate and exchange information, and support high quality activities at clubs. Nationwide support comes from partners: expert institutions helping us develop the programme and enhance it with new elements.

In 2019, we launched new activities aiming to bolster the independence of our **regional partners**.

Copernicus specialists created a group of school coaches. Their aim is to improve the skills of regional partners and club leaders they appoint. In 2019, 18 people selected by YEC regional partners met our coaches three times. They honed their skills at working with adults and learned more about ways of teaching and learning promoted by YEC. They also worked on devising the programme of the 8th YEC Forum.

Strategic partner

Polish-American Freedom Foundation

Nationwide partners

- Polish Children's Foundation
- Children's University Foundation
- Polish-German Youth Office
- Good Education Foundation (new partner)

Regional partners

- ExploRes Association, Rzeszów
- Youth Astronomical Observatory, Niepołomice
- Teacher Training Centre, Olsztyn
- Łódź Children's University at the Łódź University of Technology
- Vocational High School, Chełm
- Technical and Vocational School Complex and Centre for Continuing Education, Leszno
- Wrocław University of Science and Technology
- University of Białystok
- Silesian Intercollegiate Centre for Education and Interdisciplinary Studies in Chorzów
- Centre for Crafts and Dual and Vocational Training in Kalisz (new partner)
- WSB Banking University in Gdańsk (new partner)
- Casimir the Great University in Bydgoszcz (new partner)

Partner for programme development abroad

- "School with Class" Foundation

International partner

- Ilia State University Tbilisi, Georgia
- Mekelle University, Mekelle, Ethiopia

YEC programme abroad

The YEC programme is international in scope. Thanks to collaboration with the partner for developing the programme abroad, the **"School With Class" Foundation**, the number of clubs outside Poland's borders is increasing. In Georgia, the programme partner is **Ilia State University in Tbilisi**, with whom we are working to bolster the Georgian YEC network. The university coordinates the program in Georgia and independently organizes such major activities as the YEC Forum in Tblisi. The second edition of the forum was attended by some of the co-creators of the programme from Poland. Copernicus also hosted teachers from Batumi for a study visit, and YEC leaders from Georgia attended the 8th YEC Forum in Warsaw. Such visits and exchanging of information have helped YEC leaders from both Georgia and Poland further hone their skills and disseminate good YEC practice.

In Ukraine, we will be developing YECs in a special consortium with the Lviv Dovzhenko Centre, Insha Osvita, the Impact Hub Odessa, and the Science Centre Ternopil (the latter was created thanks to cooperation with Copernicus and the promotion of the sciencepicnic idea in Ukraine). In Armenia, the partner institution will be the Byurakan Astrophysical Observatory, supported by the Jinishian Memorial Foundation. We will also be launching YECs in Ethiopia, where we have signed a Memorandum of Understanding with Mekelle University as the partner institution. Clubs also exist in Lithuania, where we began collaborating with Vytautas Magnus University in Kaunas, the programme coordinator, back in 2016.

8th YEC FORUM

The annual **YEC Forum** is an important event for the entire Young Explorer's Club community. The 2019 Forum opened with a lecture by teacher and journalist Jan Wróbel. The founder of a school complex in Warsaw talked about the power of cooperation, about learning from others and about working as part of a network. The **Idea Exchange** provided an opportunity to discuss best practice and meet new contacts. Over twenty club leaders presented initiatives implemented at their clubs. Several stands presented experiments, and each participant could attend up to three workshops to help them gain new skills and experiences. These included short practical sessions led by regional instructors and experienced club leaders and four-hour-long sessions. **Workshops held in the exhibition space** taught participants to design exhibits similar to those found at Copernicus, and visitors learned about our programme. The forum was attended by 200 club leaders, 50 guests from educational circles and 15 guests from Georgia, Ukraine and Armenia.

Workshops for YEC mentors

As part of our developing relationship with regional partners, we held 18 training sessions on running Young Explorer's Clubs. The workshops, attended by around 200 people, were held in Warsaw, Białystok, Kalisz, Rzeszów, Chorzów, Bydgoszcz, Gdańsk, Wrocław, Łódź and Olsztyn. During eight-hour-long sessions, new and beginner mentors learn about YEC ideas in practice and find out how to support club members in independent discovery of the world of science through experimentation. The meeting is an opportunity to learn about the programme and its values, to share experiences in running clubs and to introduce new club leaders to the programme's history.

We also hosted two-day-long workshops **"Curiosity is the first step of research"** for 15 club leaders we have been working with for several years. The aim of the meeting was to promote the inquiry-based methods; we believe that using them in teaching helps club members and leaders develop their skills in critical thinking and learn about the world around them in a methodical way. Advanced club leaders also attended day-long workshops **"Good quality questions"**: 15 educators followed a scenario developed during workshops held as part of the SCS project.

Competitions

Each year we host two competitions as part of the YEC programme. The competition for best experiment scenario linked with the latest Science Picnic is aimed at club members. Authors of winning scenarios present their experiences during the Picnic. This year, six teams from across Poland presented their work. The second competition, YEC Researchers, is for club leaders preparing plans of research projects. In 2019, authors of the most interesting research projects received equipment funded by the Polish-American Freedom Foundation. The committee also decided to award grants for the implementation of research projects.

The second conference for teachers and heads of schools promoting the YEC programme and learning through experimentation was held in Chorzów. Science festivals and regional picnics in Chełm, Rzeszów and Warsaw brought together around 300 people.

Dream Designers

Dream Designers is a programme encouraging children to study science, technology, engineering and mathematics (STEM) subjects; it helps us meet our strategic goal of supporting learners in constructing knowledge based on their own experience. In recent decades, Europe has seen a drop in popularity of science and technology professions – jobs which will be key in future development and economy, both which are increasingly defined by state-of-the-art technologies. We want our activities as part of Dream Designers to popularise science among today's children and teenagers so that they consider a career in STEM in the future; this in turn will have an impact on the functioning of society in a more technologically advanced reality. Alongside CANSAT, Dream Designers is one of our major endeavours which engages participants in construction challenges. We encourage **students and teachers** to take up a set engineering challenge, leaving them free to choose their method and activities.

The first two editions of Dream Designers were aimed at members of Young Explorers' Clubs (more about the YEC programme on p. 40). The first session used the "Dream Designers" educational kit revealing secrets of the engineering profession. Club members designed various gadgets, built and tested prototypes, and continued improving them until they came up with a final version. During the second edition, we supplied club members with designs for mobile makerspaces fitted with tools, microcontrollers and basic disposable materials. All this was placed on a specially constructed trolley, which served as a workspace and place to store tools. We also held a competition for students to build their own mobile workshops and design a construction which explored motion. The third edition was guided by results of evaluations of the previous two sessions. This time, we stepped beyond the YEC programme and invited all schools to participate. Our evaluations helped us identify barriers preventing students from participating in the programme. We discovered that the participants lacked key soft skills. We

responded by preparing a cycle of **12 webinars with experts** exploring topics covering design thinking, teambuilding and teamworking, dealing with setbacks, and presenting results in a clear and attractive way. The other issue revealed by the survey was lack of access to necessary equipment and space for research. We responded by preparing a **mini grant competition**. In 2019, 11 teams from all over Poland received financial support to build mobile trolleys fitted with basic tools. Trolleys built as part of the project were used to create competition projects: prototypes of equipment used to solve problems of production, storage and waste of food. The most fascinating constructions were presented during the Przemiany Festival (more about the festival on p. 32).

We run the Dream Designers project jointly with **Boeing**.

ESERO programme

The European Science Education Resource Office (ESERO) is the educational arm of the **European Space Agency (ESA)**. The aim of the programme is to promote science and technology among students by introducing elements of space exploration to school curriculums. Activities and materials designed by ESERO teach, inspire and motivate young people, and help them gain competences essential in the 21st century, including technical and soft skills.

The Copernicus Science Centre is the coordinator of **ESERO-Poland**. By working alongside ESA on implementing the programme, we have free access to the know-how of other countries' offices and resources developed at ESA headquarters and in individual countries. ESA also provides financial support, and the agency's experts participate in numerous research and engineering projects. In turn, we share our experience in education based on constructivist ideas, giving us an influence over the direction of space-themed education in Europe.

ESERO-Poland's activities

The **Space at Schools Conference** is a two-day long event providing a platform for discussion and exchange of experience in space education. All lectures, workshops, discussions and film screenings focus on the topic of space exploration. Subjects featured at the conference include potential new directions of space exploration, motivations and reasons for these kinds of studies, and the future of humankind beyond Earth. Most importantly, the conference discusses how all these issues can be introduced to lessons in computer science, maths, geography, physics, chemistry and technology while using active teaching methods.

Workshops held at Teacher Training Centres. We ran training courses for teachers in collaboration with Teacher Training Centres in Szczecin and Białystok and with the WroSpace association. Participants learned about how to use engaging methods of education in natural, mathematical and technical subjects.

ESERO Space Ambassadors. Each year we invite seven active educators to join the ESERO ambassador programme. As part of the programme, ambassadors hold workshops for educators, classes for kids and teenagers and picnics and other events focusing on space exploration. Participants in past cycles remain involved in the programme, so the number of ambassadors increases every year.

Galaxy of Women is a cycle of regular meetings for girls from high schools and young female scientists, engineers and managers who are successful in their careers. We want the meetings to inspire and motivate young women to not be afraid of new challenges and reach their goals. The format is of free discussions, helping reduce the distance between all participants in the meetings.

The **Astro Pi Challenge** aims to encourage students to write code, learn about computer sciences and develop their logical thinking skills. Participants in the challenge had a **choice of two missions**. Mission Zero involved writing a code for displaying test messages onboard the International Space Station (ISS). The Space Laboratory Mission gave students access to sensors and a computer onboard the ISS. The task was to develop code for the ISS to collect and analyse data; for example, data obtained by the moisture sensor was used to calculate whether an astronaut was present in a given section of the station.

The **CANSAT Competition** is all about learning through construction. Not all students passionate about space are able to build and launch their own research minisatellites! Every year, teams of students gather at an army training ground near Stalowa Wola for the finals of the CANSAT competition. The aim is to design a study or demo training mission which will be conducted using apparatus placed in a container the size of a drink's can. Once they are ready, minisatellites are launched to an altitude of 2 km and take measurements during their parachute descent.

Pictured: finals of the *CANSAT 2019* competition

Minisatellites take months to develop: students need to gather equipment, design and program the apparatus and then fit it in the container, starting by building prototypes and reporting their activities to the jury. Once they are ready, they build the final structure which will be launched into the sky and take measurements. We know that the moment when the satellites are launched and then when they fall to the ground is eagerly awaited by the participants as it is the culmination of their hard work on the project. For us, the aim is to take young people through the entire mission process, from conceptualisation, building prototypes and finally the mission itself, culminating with collecting data and presenting results.

During the finals of one of the past competitions, there was an accident where one team lost their minisatellite; this meant they couldn't take part in the next stage of the competition and all their months of hard work seemed to be in vain. Forgetting all about the competition aspect of the event, members of other teams immediately **took out subsystems from their backup minisatellites** and helped their friends rebuild their device in a single evening. They certainly aced the test in empathy and solidarity!

The Polish finals of CANSAT are financed by Boeing.

Educational kits for hire. As part of the ESERO-Poland programme, we lend out two educational kits: the **Spacecraft Materials Kit** and the **Astro Pi Kit**. The Spacecraft Materials Kit is used to study electrical and thermal conductivity, elasticity, mass and magnetism of different materials. Participants test which materials included in the kit are the most suitable for building elements of spacecraft. Astro Pi teaches the basics of programming and includes a Raspberry Pi microcomputer, sensors and a LED matrix.

Together with the Foundation for Young Science we launched our first **massive open online course (MOOC)**. The topic of the course is "Using satellite images in education". The course is open to educators and teachers of subjects including geography, physics, biology, chemistry, history and social studies.

The course covers remote sensing; it is presented in a way which is accessible to non-experts and can be easily adapted for lessons with young people. On completion of the course, participants can download, process and analyse satellite images using the EO Browser, and present and discuss selected natural phenomena captured in these images.

Skills and abilities gained during the course will help teachers prepare engaging, original lessons based on state-of-the-art technologies and innovative teaching methods such as inquiry-based learning, critical pedagogy and global education.

The course comprises six modules, each of which covers five to six lessons. The modules are Satellite Images, EO Browser, My Environment, Water, Vegetation and Biodiversity, Weather and Climate, and Society and Economy.

The ESERO-Poland programme is co-financed by the European Space Agency.

Lay Out, Let Out Conference

Why we meet

The Lay Out, Let Out conference is an annual meeting for teachers and educators. We aim to create an environment for education practitioners centred around the conference and to get them involved with Copernicus. This year, we examined the role of teachers in the realities of the 21st century, with the ongoing social and technological progress forcing the education system to evolve. In Poland, the role of teachers has recently been put in new contexts as a result of tensions in the profession, due to the latest round of education system reforms and teacher strikes.

Lectures

The conference featured three lectures. Prof. Tomasz Szkudlarek, director of the Department of Philosophy of Education and Cultural Studies, Institute of Education, University of Gdańsk, talked about how the role of teachers has evolved over the centuries. Dr. Sharon Friesen, professor at the Werklund School of Education, University of Calgary, discussed using the latest teaching methods to help improve student engagement and independence. Prof. Barbara Fatyga, director of the Department of Culture Research Methods and the Youth Research Centre at the Institute of Applied Social Sciences, University of Warsaw, talked about who today's learners are.

Workshops and debates

Teachers were heard most clearly during debates where we discussed issues such as how teachers can become their students' partners without losing authority, the role of the humanities in contemporary education, and whether there is life beyond the curriculum. The discussions on the daily challenges and difficulties facing teachers stirred powerful emotions. During workshop sessions, teachers learned about inquiry, project and problem-based learning.

The conference was followed by a publication including articles by key presenters, interviews with participants, debate summaries and descriptions of inquiry, project and problem-based learning.

14th Civic Congress

In 2019, we hosted and prepared the programme of the 14th Civic Congress, with Robert Firmhofer, CEO of the Copernicus Science Centre, sitting on the Programme Board. The question posed by the event was "Poles in the 21st century: together, but how? Focused around principles, opportunities or threats?" Our Educational Lab and Events Lab developed and hosted the educational session "Together, but how? Education in the wake of reforms and strikes" The session had a reversed science cafe format, bringing together teachers, educators, representatives of NGOs, students, parents and representatives of local authorities.

High-school students made important contributions to the session, putting forward their perspective on some of the major issues facing Polish education, such as insufficient collaboration within educational boards, rivalry among teachers, and the sense of isolation among active, engaged teachers.

The recommendations emerging from the session will be published later this year, while the audio files are available on the website of the Civic Congress.

Wars and Sawa programme

The Wars and Sawa Programme, co-organised by the Warsaw Centre for Socio-Educational Innovation and Training and the Copernicus Science Centre, has been running since 2011. We have been active participants since the beginning, providing support for teachers working with gifted students and hosting the annual **Summer Seminar**.

The aim of the programme is to identify and develop student potential and to build and encourage internal motivation to learn and progress. The Summer Seminar is an annual meeting for teachers participating in the programme and concluding their work over the course of the schoolyear. The Seminar also provides support and inspiration for future activities, and is an opportunity for Copernicus to present our educational activities. A coordinator of the YEC programme (more on p. 40) talked about her club with such enthusiasm that we had to hold a **YEC for Beginners** workshop immediately after the Seminar.

The event also bolsters the presence of Copernicus in the educational circles in the region, in particular among teachers in Warsaw, which is an important activity in terms of increasing attendance of school groups from Warsaw and its surrounds.

Pictured: *Lay Out, Let Out* conference 2019

Part 8. Behind the scenes at Copernicus

International and national partners

We share our vision with many other institutions in Poland and abroad. We can achieve more by joining forces and working together. We want to engage sciencecommunication communities by being active participants in associations and programmes on a national and international scale.

Ecsite is the European Network of Science Centres and Museums, headquartered in Brussels. Robert Firmhofer, CEO of Copernicus, is one of the trustees of Ecsite, Wiktor Gajewski, Events Director of Copernicus, is a member of the editorial committee of the association's magazine "Spokes", while Joanna Kalinowska, Development Director of Copernicus, is a former member of the Ecsite Annual Conference programme committee.

Copernicus is a member of **EUSEA** (European Science Engagement Association).

Members of the **Association of Science and Technology Centers (ASTC)**, headquartered in Washington D.C., include science centres and museums, planetariums, botanical gardens, oceanariums, natural history museums and other institutions which use innovative approaches to education to inspire people to discover the importance of science in everyday life. It has approx. 650 members from 50 countries. Copernicus CEO Robert Firmhofer is a member of the board of ASTC. Since 2017, Copernicus has had the prestigious status of being a governing member.

We are also members of the **International Programme Committee (IPC)** of the Science Centre World Summit. Copernicus CEO Robert Firmhofer is a member of the IPC as part of his work with ECSITE.

IPS (International Planetarium Society)

ILDA (International Laser Display Association)

Big 5 is a think-tank comprising five directors of major science centres and museums in Europe: Museo Nazionale della Scienza e della Tecnologia Leonardo da Vinci in Milan, the Science Museum Group in London, Deutsches Museum in Munich, Universcience in Paris and the Copernicus Science Centre in Warsaw.

The **SPiN Association** brings together science centres and other institutions working in informal education in Poland. Copernicus CEO Robert Firmhofer is a member of the board of SPiN. As part of the association, we have been co-organising the SPiN Day since 2015, and the Interaction – Integration Conference founded by Copernicus. The programme team of the conference is led by Dorota Wiślicka from the Copernicus Science Centre.

The **BLOOM (Boosting European Citizens' Knowledge and Awareness of Bio-Economy Research and Innovation)** project runs between 2017 and 2020. Copernicus and the Agriculture University in Kraków are one of five European hubs bringing together individuals and institutions working in bioeconomy. We host creative workshops and activities in science communication.

The **ReThink Project**, coordinated by the University of Bristol, studies science communication communities in different countries in Europe. As part of the project, we put together a group of instructors who will help scientists and researchers improve their science communication skills. The team will include individuals focusing on issues of climate change and AI.

Sponsors

Strategic partner

Samsung Electronics Poland has been Copernicus Science Centre's strategic partner since our foundation. Samsung supplies Copernicus with electronic equipment and provides financial support. In 2019, Samsung and Copernicus hosted the third Discovery Day. Samsung funded free entry for all visitors for the day; as well as the usual attractions, guests enjoyed an additional 11 zones co-developed with Samsung and featuring state-of-the-art technologies. Visitors converted their smartphones into microscopes, learned how air purifiers work, explored 3D anatomical atlases and discovered the magnetic sensor in their phones. Samsung also loaned us ultrasound equipment used by experts at the "Measuring Man" competition and supplied 32 inch screens for the exhibition at the Przemiany Festival. The company also provided an advertising screen in the centre of Warsaw.

Events we organise together form a part of Samsung's corporate social responsibility strategy and meet our strategic goal of providing top-quality experiences for the million visitors we receive every year.

Samsung a partner of the After-Hours evenings for adults, the exclusive partner of the Robotic Theatre and a sponsor of the Copernican Revolution Lab.

Supporting partners

Polkomtel, operator of the Plus mobile network, has been supporting the Copernicus Science Centre since our opening in 2010 by sponsoring the Ringtones Generator exhibit. It has also been the patron of our Family Workshops since 2014. We developed the scenario "Making Contact" as a result of our work with Plus. The first workshops following this scenario were held in January 2018. Since 2017, Polkomtel has been supplying free Wi-Fi available to visitors of all of the Copernicus Science Centre and the Discovery Park.

The energy company **innogy Polska** has been supporting Copernicus since 2012. In 2019, the innogy Foundation in Poland and Copernicus ran miniworkshops using the Power Box kit devised by our experts. Participants in miniworkshops learned about electricity and ways of measuring it. By conducting experiments, they discovered how to obtain energy from sunlight and how wind turbines operate.

innogy Polska is the exclusive partner of the High Voltage Theatre and Tesla Day.

Exclusive partners of our Laboratories, EduFactory and Thinkatorium

BASF Polska is the exclusive partner of our Chemistry Lab. BASF is a global chemistry company developing solutions for a sustainable future. The company's goal is to provide improvements to environmental protection, promote intelligent energy and popularise education in chemistry. In 2019, the educational programme Chemiatomy at the Chemistry Lab included several workshops devised by BASF and titled "Colours in Chemistry". During the workshops, kids aged between 5 and 13-years-old conducted experiments, made recycled paper, learned about electrolysis and dendrite trees, found out how to change the colour of a solution, observed dry ice and watched the demonstration "Elephant Toothpaste".

Raytheon is the Exclusive Partner of our Robotics Workshop and the EduFactory. The company is a global leader in technology and innovation specialising in defence, national security and cybersecurity. In 2019, Raytheon sponsored Copernicus visit for a hundred children being cared for by various NGOs in Warsaw. Financed by Raytheon, the FabLab is involved in a R&D project testing models of how technology can be introduced into education.

The Exclusive Partner of our Thinkatorium is **Würth Polska**, which joined us as a partner in 2018. The company is a worldwide wholesaler and distributor of products such as fasteners, chemicals and tools, active in the Polish market for the last 29 years. Würth Polska is a modern, innovative company which has been actively supporting science and culture for many years.

Partners of the Copernican Revolution Lab

The main partner of the Copernican Revolution Lab is **Samsung Electronics Polska**.

The investment partner of the Copernican Revolution Lab is **Saint-Gobain Innovative Materials Polska**.

Special Event Partners

The partner of temporary exhibitions and Discovery Day is **Samsung Electronics Polska**.
Boeing finances the Dream Designers project (more on p. 43) and finals of the CANSAT 2017 competition.
innogy was our partner for Tesla Day.

Programme partners

The **Polish-American Freedom Foundation** is the partner of the Young Explorer's Club programme.

The **European Space Agency** is the partner of the ESERO-Poland programme.

Partners of activities and competitions

Polkomtel, operator of the Plus network, was the exclusive partner of the Family Workshops.
Kościuszko Foundation were partners of FameLab.
This year's Science Picnic was supported by Bayer, the Ministry of Energy, the National Centre for Research and Development, the Polish Chamber of Information Technology and Telecommunications, and Viessmann.

Our Team

Programme Council of the Copernicus Science Centre

Prof. Łukasz Turski, PAS Center for Theoretical Physics – Chair of the Council

Prof. Aleksander Bursche, Faculty of Archaeology, University of Warsaw – Deputy Chair of the Council

Prof. Marek Abramowicz, professor emeritus of Chalmers University, Göteborg

Prof. Roman Cieślak, Rector of SWPS University of Humanities and Social Sciences, Warsaw

Prof. Magdalena Fikus, professor emeritus of the PAS Institute of Biochemistry and Biophysics

Catherine Franche, Executive Director of Ecsite (European Network of Science Centres and Museums)

Maya Halevi, Director of the Bloomfield Science Museum in Jerusalem

Prof. Dariusz Jemielniak, head of the MINDS (Management in Networked and Digital Societies) faculty at Kozminski University, Warsaw.

Maria Mach, Director of the Polish Children's Fund

Mirella Panek-Owsiańska, expert on Corporate Social Responsibility and social communication; co-founder of the "Space for Girls" Foundation.

Prof. Tomasz Sowiński, PAS Institute of Physics

Dr. Barbara Streicher, Executive Director of the Austrian association ScienceCenter-Netzwerk

Prof. Tomasz Szkudlarek, head of the Division of Philosophy of Education and Cultural Studies, Institute of Education, University of Gdańsk

Prof. Jan Szmidt, Rector of the Warsaw University of Technology

Rosalia Vargas, President of the "Ciência Viva" Portuguese national agency for the promotion of initiatives for the public awareness of science and technology and Director of the Pavilion of Knowledge in Lisbon

Hanna Wróblewska, Director of the Zachęta National Gallery of Art

Management of the Copernicus Science Centre:

Robert Firmhofer – CEO

Irena Cieślińska – Programme Director

Ewa Kloc – Administrative Director

Joanna Kalinowska – Development Director

Anna Dziama – Education Director

Wiktor Gajewski – Events Director

Barbara Juszczak – Deputy Administrative Director, Chief Accountant

Anna Lipińska – Visitor Experience Director

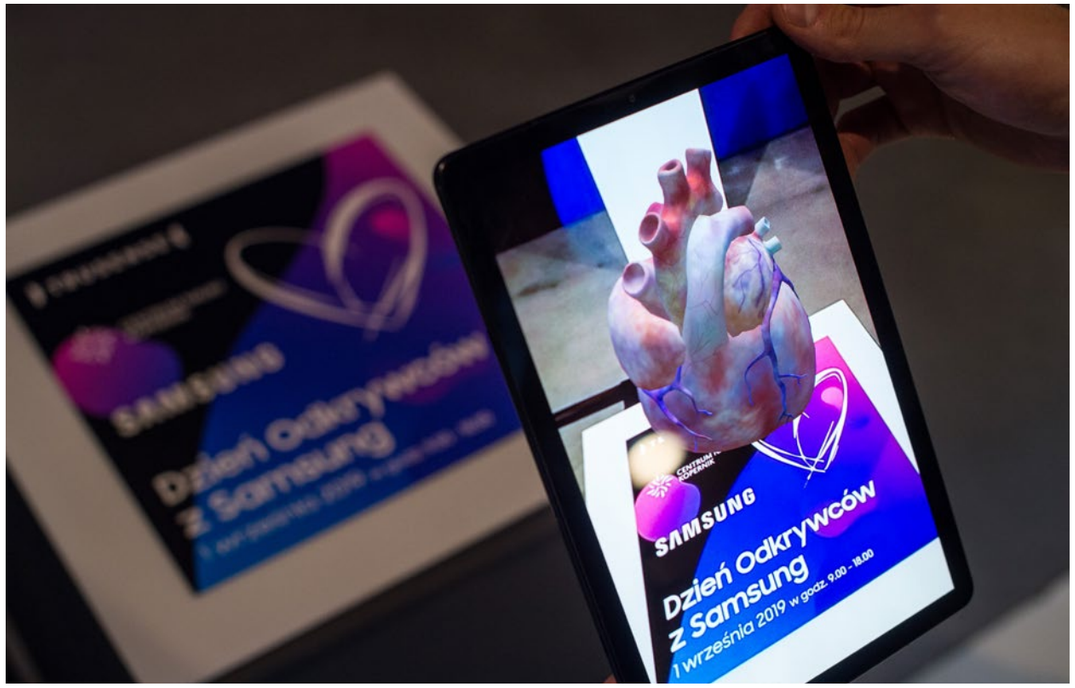
Przemysław Wielowiejski, PhD – Investment Director

Aleksandra Wójcik-Głodowska, PhD – Innovations Director

Who we are

As at 31 December 2019, Copernicus employed 354 people (together filling the equivalent of roughly 321 full-time positions), including 138 men and 216 women. Statistically, we are under 40 – the average age of our employees is almost precisely 36 years old. Moreover, 55 of our staffers are still below age 26.

We employ scientists, people passionate about science, and – first and foremost – people who are experts in their fields. Providing top-quality experiences for the million visitors to our Exhibitions and Planetarium every year, myriad educational and artistic activities, maintaining a voice in social debates and



Pictured: Samsung has been supporting us with state-of-the-art equipment for many years. *Discovery Day with Samsung*

providing entertainment all require a veritable army of efficient, enthusiastic employees. Luckily for us, the Copernicus Science Centre has just such an army!

In 2019, our permanent staff numbers increased significantly, since we revamped the system of employment for our explainers working in the exhibition space. Through the end of 2018, 200–250 explainers had been employed under temporary (annually renewed) contracts, and some 30–40% of this group would be replaced each year. In 2019, however, 68 such individuals were hired as permanent employees, together filling the equivalent of roughly 57 new full-time staff positions. This form of employment entails additional costs for Copernicus, but we believe it will improve staff morale, their engagement in working with visitors, and it will enable the explainers to benefit from many paths of development.

It is important to us to maintain a good atmosphere – an audit that was carried out named this as a strong point of our institution. We make numerous efforts to ensure that working at Copernicus is attractive, which is not easy given the competitiveness of the market. Hiring and keeping talented employees is a challenge. In 2019, we carried out as many as 77 recruitment procedures, as a result of which we took on 141 individuals. We are also striving to especially appreciate our employees with long years of service.

We work hard to ensure the professional and academic development of our staff members. In 2019 we organized more than 200 training sessions, some of them carried out for larger groups of employees. Subsidized funding for foreign-language learning was obtained by everyone interested, in other words by 38 staff members. Twelve received assistance with fees for university education. Moreover, employees participated in several dozen different conferences in Poland and abroad.

We encourage and facilitate our staff's pursuit of scientific credentials. Under the "Implementation Doctorate" program announced by the Polish Minister of Science and Higher Education, two Copernicus staff members are working towards their PhDs at the SWPS University of Humanities and Social Sciences, while one is studying at the interdisciplinary doctorate program run by the Polish-Japanese Academy

Pictured: *Discovery Day with Samsung*

of Information Technology in collaboration with the SWPS University of Humanities and Social Sciences

In 2019, we unexpectedly had to look for a new location for an additional office. Unfortunately, we did not manage to find any appropriate location nearby the Copernicus building itself. Having our staff function at two different sites situated some distance from one another requires greater organizational and financial effort. The move was a huge logistical challenge for the whole institution – within a short time, we had to relocate the workstations of more than 140 staffers.

The Copernicus Science Centre is a cultural institution.

Its organisers are the Capital City of Warsaw, the Minister of Science and Higher Education, and the Minister of National Education.

Legal Basis

Agreement from 1.06.2005 on creating a joint cultural institution named the Copernicus Science Centre, with annexes from 21.06.2006, 26.07.2010, 24.06.2014 and 3.11.2015.

Granted the status of a cultural institution named the Copernicus Science Centre on 1.06.2005, with amendments from 21.06.2006, 26.07.2010, 24.06.2014 and 3.11.2015.

Polish Parliamentary Act dated 25.10.1991 on organising and implementing cultural activities

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