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The volumetric 3D-model of the Cat's Eye Nebula (NGC 6543). Created by Wolfgang Steffen & Nico Koning of Ilumbria.

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IN FRONT OF THE CONSOLE

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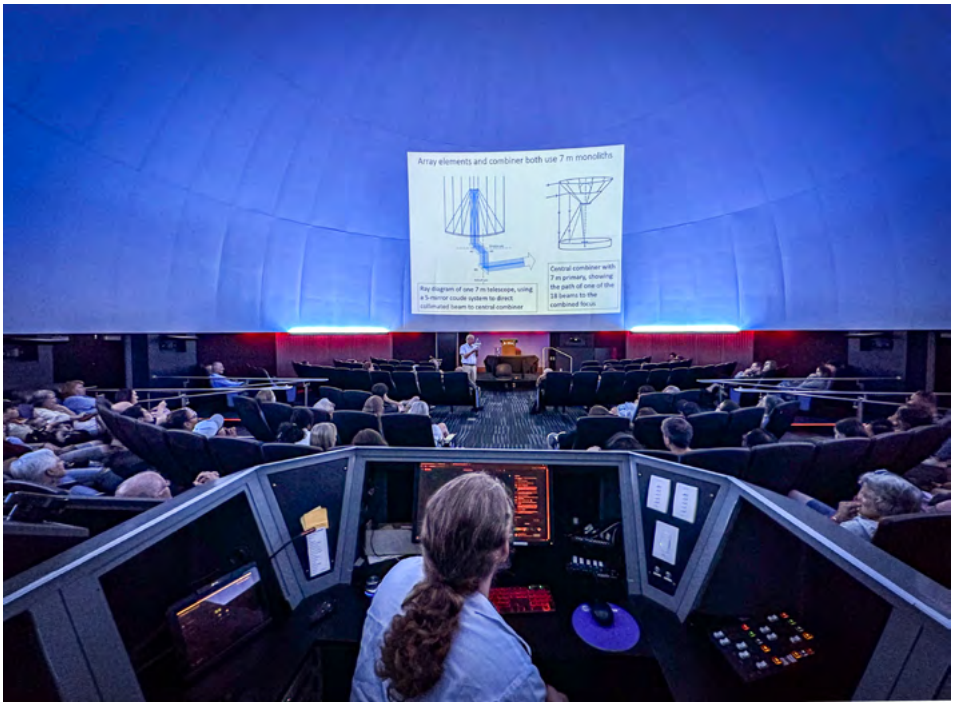

The audience listens intently during Regents Professor Roger Angel's "Science at Sunset" presentation.

We usually experience a little bit of slowdown towards August - people are finishing up their vacations, kids are getting ready for school, and we here take that time to prepare for the fall.

That...was not the case this year.

It has been a hectic summer for the Planetarian journal team. The months flew by in a flash with no time to process the spring, celebrate the summer, or prepare for fall. I suppose one cannot be totally angry; after all, it's always good busy, right? (Even if I tend to forget to take a breather...) Sometimes that's just what happens — life catches up with us all, and it reminds us that our best-laid plans are at its mercy. So thank you once again for your patience.

I didn't have much time with training wheels, so to speak, after Michael's retirement. I felt like I had to hit the ground running, which is pretty much how I feel like most things in my life are. I have to make decisions! New shows? New hardware? What are the next five years going to look like? Who put me in charge!? (To be fair, I wanted the position) Do you ever feel like you're just ready to make decisions? Probably not. But at least I know that Michael is just a call away, ready and willing to hear me panic. (Just a heads up, Michael).

This summer, we kicked off a brand new series at Flandrau called "Science at Sunset". It's a multi-part evening event where we invite scientists from the University of Arizona to share their science, their research, and their passions with very excited audiences. We also like to pair it with a fulldome show, and then we top off the evening with a night sky talk. Our exhibits are open and we've been able to offer telescope viewing a few times (hello monsoon storms!) as well.

I was so nervous at the outset. Would people come? Would they find the topics interesting? So far they have! Our first was titled "Big Mirrors, Big Aspirations", which featured Regents Professor Roger Angel, speaking about the largest astronomical telescopes being built on Earth today and sharing some proposals for building a large telescope on the surface of the Moon. We were able to share NOIRlab's "Big Astronomy" that night as well, which, if you have not seen it, you should. Next was "Dark Skies, Dark Energy", featuring Stephanie Juneau, talking about DESI, or Dark Energy Spectroscopic Instrument, which is installed on the Mayall Telescope installed on Kitt Peak located 55 miles west-southwest of Tucson. It was paired with "5000 Eyes". Our latest was "Mighty Monsoons", featuring Climate Science Specialist and Environmental Science Professor Michael Crimmins, speaking to the storms we depend on here in the desert, and showcased Fiske's "Climate Change in Our Backyard".

Even with the lights, visitors were able to observe craters on the moon.

To say I've been pleased with attendance would be an understatement - they've all sold out! It makes me happy knowing we can once again share the science being done on campus with our community, all while showcasing the incredible shows this community has produced.

It's a constant reminder why we do what we do. Planetariums offer such a unique experience, which you'll actually see in two of the papers featured in this issue, that allows us to reach audiences in ways that traditional methods don't. It's also a reminder of what makes this career so much fun, as we get to think outside of the box, in an awesome dome instead.

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DISASSEMBLE VOLUMETRIC MODELS FOR DIDACTIC PURPOSES?

SURE, WHY NOT?

By Wolfgang Steffen & Nico Koning, *ilumbra*

Figure 1: The volumetric 3D-model of the Cat's Eye Nebula (NGC 6543).

Teaching human or animal anatomy using models that can be disassembled to separate individual organs is commonplace in high-school or medical school. They help to better understand the structure of the body and the functions of the organs.

In live planetarium shows, you can fly around or into volumetric 3D-models to get an idea of what they are like. It is definitely better than looking at a photograph. It is a great experience and very helpful indeed.

During a live presentation in the planetarium, wouldn't it be even cooler to be able to disassemble complex nebulae and galaxies in a similar way as the biological anatomy datasets?

At ilumbra, we have taken the first steps in this direction with a set of volumetric models of the Local Group of galaxies. We have separated the infrared dust emission and the ionized hydrogen regions (as tracers of star formation) from the overall optical visualization of the galaxies.

These "segments" can be shown separately or transitioned from the usual visualization of a galaxy to just the star-forming regions and then to the dust content. This helps the presenter clarify the spatial relationships between the dust, the formation of stars, and the spiral structure.

Recently, we had a request for a model of the famous Cat's Eye Nebula (NGC 3456) for a planetarium show production. The resulting volumetric model is shown in Figure 1. The producers then asked whether we could separate the model into different parts, so they could highlight or emphasize them when needed.

We gave it some thought, and soon the lightbulb over our heads brightened in a flash; Yes, sure thing, why not? We separated the key "anatomical" ingredients of the nebula and, using our nesting technique, these partial models can now be shown individually or combined (Figure 2). Each one of them can be highlighted and controlled by the presenter.

Inspecting the different segments separately or in unusual combinations may help to clarify the differences in temporal appearance as well as their spatial relation and physical nature.

An additional recourse is "slicing." Looking at the full image of a nebula may sometimes be confusing, since it superimposes all parts that are along the same line of sight. Of course, the basic idea of a 3D-model is to help disentangle this superposition by allowing to view the objects from any angle or even from within. In at least some situations, it helps to look at only a slice.

In the full image of the Cat's Eye Nebula in Figure 1, we see that, on the outside of the elongated shell, there is a diffuse halo with radial spikes and subtle concentric rings. At first glance, they seem to be just circular as if originating from some sort of pulsation of the central star during the time when it was a cool giant. It appears to have blown something like spherical "smoke rings."

When we slice the volumetric 3D model along perpendicular planes through the central star, we obtain the images shown in Figure 3. Now, try the following: pick one of the outermost rings and place your fingertip on it. Now move along the ring. If you

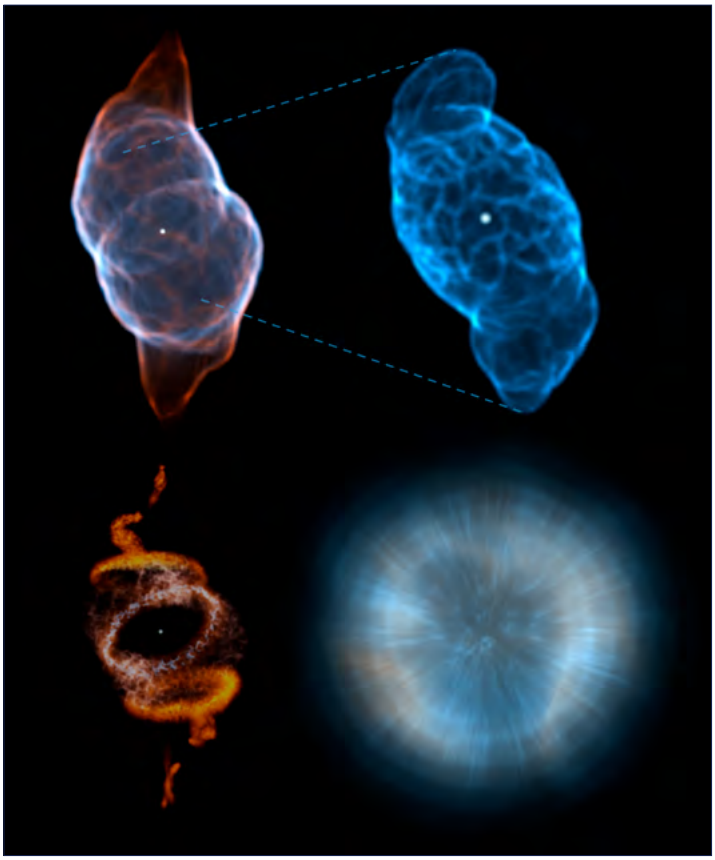

Figure 2: Segmented version of the Cat's Eye Nebula, where we have separated some of the physically key parts. In the planetarium, for didactic purposes, the segments can be combined and highlighted individually by the presenter.

go in the right direction, after a full turn, you will not get back to the origin, but rather end up at the ring that is inside your starting position. You can repeat the experiment on the slice that was taken along the elongated direction of the nebula and the result is the same. How did that happen, even though you never jumped to the other ring?

The answer is, of course, that it is not a ring, but a spiral. Actually, it is a very interesting 3D-spiral that has a lot to say about the origin of the nebula and its central star. If you continue to follow the spiral, you will reach the edge of the elongated bubble.

This spiral nature of the halo around the nebular shell is proof that the center the origin of the "rings" cannot be a single pulsating star, it must be a binary. Such a simple observation, with a dramatic scientific conclusion! This kind of three-dimensional spiral has been found in a number of planetary nebulae (Maercker et al., 2012).

In a research paper by Decin et al., (2015), we were fortunate enough to contribute a detailed 3D-model that reproduces imaging and kinematic observations of the CO-molecule in CW Leonis obtained with the ALMA radio observatory in Chile. The paper strengthened evidence from earlier observations of regular brightness variations that CW Leonis is a binary star. CW Leo is, however, at an evolutionary stage that the Cat's Eye Nebula has long passed.

We are lucky that these spiral shells can still be seen because the complex bipolar shock wave that makes up the brighter part of the nebula is expanding through it and destroys the spiral. This shock wave was produced by the fast stellar wind that the stellar remnant produces and sweeps up the slowly expanding spiral accumulating the material in a thin shell.

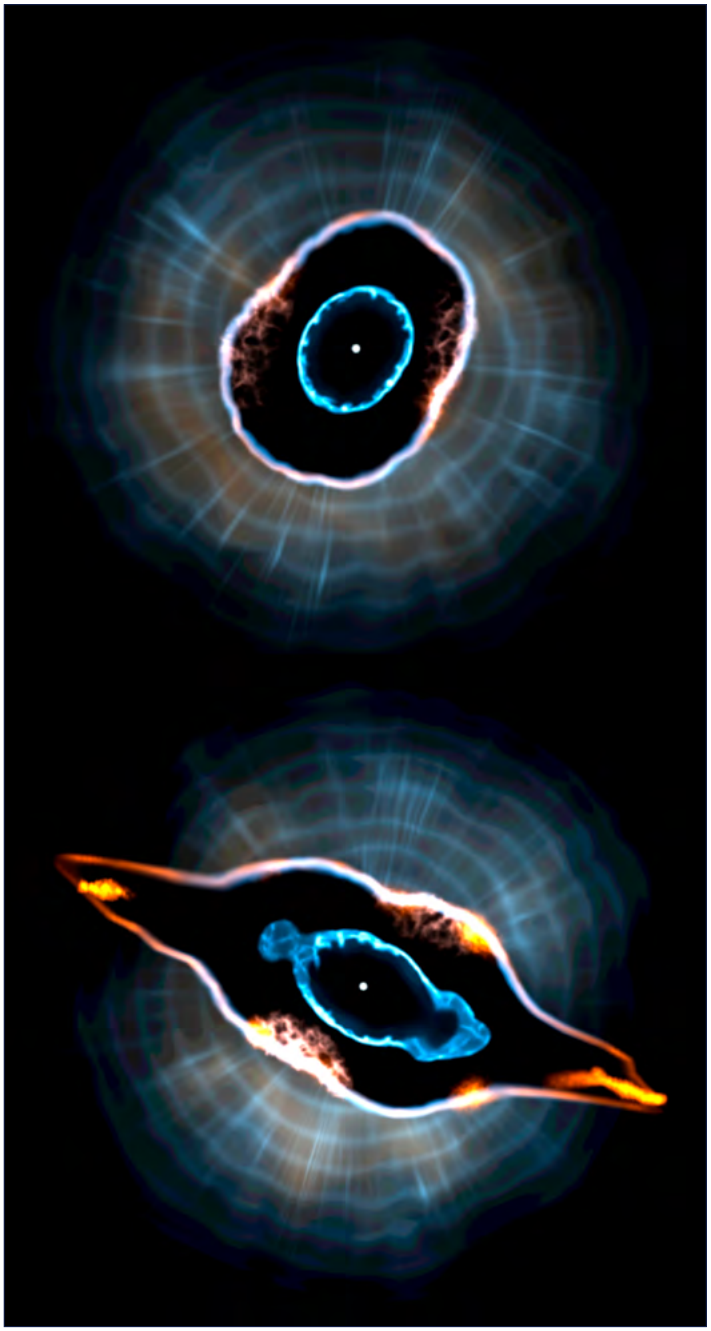

Figure 3: Thin slices of the volumetric 3D model that show the shell-like character of the inner Cat's Eye Nebula as well as the spiral nature of the rings.

The binary nature of the central star may explain the presence of the quasi-circular shells. How about the funny radial spikes that permeate the spiral halo? How do they fit into this picture? The ultraviolet radiation from the central star excites the nebula gas to shine. The densest parts of the nebula are partially optically thick to that

(Continued on pg. 76)

ENGAGING OUR COMMUNITIES:
BUILDING COLLABORATIONS TO ENRICH AND DIVERSIFY PLANETARIUM PROGRAMS

By Jean Creighton, Director, University of Wisonsin-Milwuakee Manfred Olson Planetarium

Figure 1 by Nathaniel Schardin.

Abstract

Planetarium theaters ought to be inclusive spaces. To reach this goal, planetarians are encouraged to develop meaningful, long-lasting partnerships in their communities. I will share three approaches we have used at the University of Wisconsin-Milwaukee Planetarium to build such partnerships. The first involved co-creating content with six Indigenous cultures and languages of Wisconsin for the program "*Indigenous Voices: Sharing the Wisconsin Sky*." For the second approach, we invited African American community leaders and artists to present in the planetarium as well as UWM African alumni, faculty, staff, and students to share cultural perspectives and experiences. The third involved working with the Student Muslim Association and the Milwaukee Muslim Women's Coalition to highlight the many important Islamic connections to the sky. These partnerships build over time and are wonderful ways to grow both professionally and personally. Be prepared to listen, learn, and respectfully ask questions.

Our profession is eager to serve our communities and yet, there is plenty of evidence that planetarium audiences often don't reflect the diverse demographics of their communities; our audiences tend to be more affluent, educated, and white (Peterman et al., 2022). It is important to point out that this disparity is not reflected in people's *interest* in science. As a response, planetarians have put out the call "to develop reciprocal and meaningful relationships with local neighborhoods and community groups to create more inclusive learning environments for the future (Peterman et al., 2022)."

During the last decade, I have cultivated partnerships across campus and beyond to ensure the planetarium serves a broader group of people. I want to share some examples of what this can look like. All these collaborations have brought in more diverse audiences, led to programs that are richer in content than what we could possibly have produced on our own, and helped facilitate more nuanced understanding of other cultures.

1. Collaboration with the Electa Quinney Institute for American Indian Education

Since 2010, I have been eager to work with Indigenous scholars to create public programs highlighting Indigenous astronomy in the region. As I found out, these collaborations take time because people need to build relationships and trust. After reaching out to various people, I finally found a person interested in the project in 2014, Margaret Noodin, who teaches Ojibwe. We have been building capacity ever since. We have submitted three Advancing STEM Informal Learning (AISL) National Science Foundation (NSF) Grant applications. During the preparation of these applications, we worked with people from different Nations in the region, prepared material to support programs at the Indian Community School in Franklin, WI, and now infuse our regular planetarium programs with references to Indigenous astronomy.

In 2018, faculty, staff, and students associated with the UWM Planetarium and the Electa Quinney Institute for American Indian Education (EQI), in collaboration with community members, created a series of programs called "Indigenous Voices: Sharing the Wisconsin Sky" (see Figure 1). The idea behind the programs was to find astronomical terms, ways to map the sky, and cultural connections to stargazing (Creighton & Noodin, 2018) for each of the Indigenous languages and cultures of Wisconsin (Ho-Chunk,

Figure 2 (top) and 3 (above) by Jean Creighton.

Menominee, Ojibwe, Oneida, Potawatomi, Stockbridge-Munsee). We were also hoping to celebrate students at UWM who identified as members of these Nations.

Our original series was very successful: Members of different nations visited the planetarium to present and learn, and members of our local community, including urban American Indians, participated in the programs (Figure 2). Some of our goals were hard to achieve at the time. For example, we identified only a very few Indigenous star stories. However, we connected with Mike Zimmerman Jr., a local scholar who is knowledgeable about the night sky and fluent in three regional languages (Ojibwe, Potawatomi, and Odawa). We were unable to find any celestial words in Ho-Chunk or Mohican (the language spoken by Stockbridge-Munsee people). We are planning to augment this work by recording Mike and researching more words (especially in Ho-Chunk and Mohican) with the help of new language teachers at UWM. The entire program will be archived at the University of Wisconsin-Milwaukee Library.

Benefits

One of my favorite moments of "Indigenous Voices" was when Katinee Shawanokasic and Monea Warrington (Figure 3), two Menominee women, spoke in the planetarium to a full house, which included 15 teenage Menominee girls visiting from their reservation. The sparkling eyes of the young women manifested their pride that two women from their community were in positions of authority in a university planetarium.

This anecdote demonstrates some of the benefits of this type of work: Not only do you become an ally in a more meaningful way, you get to celebrate different peoples' cultures and languages and make them more visible in the community.

Another great aspect of this is that you can add other constellations or names during the stargazing portion of our other public programming, even if the topic of the presentation is unconnected. General audiences are interested in how the sky was made sense of by the people who were here first.

Challenges and Suggestions

Work with Indigenous groups takes time because they are weary of people who make meteoric appearances: They show up out of nowhere, stay bright for a short burst, and then disappear, never to be seen again. It takes **time** (think years, not weeks) and persistence to show that you are interested in a long-term collaboration and that you are willing to follow their needs and timelines.

You will need to educate yourself through conversations, webinars, and articles. Give people your time to meet. I gained some important insights during regular meetings with people from different nations while we were working on the three NSF grants. During those regular interactions, I got glimpses of a world different than mine. For example, it was striking how different the impact of the pandemic was on the Indigenous members of the collaboration: Everybody had funerals to go to, not just for community Elders but also for middle-aged and young people. It was sobering to hear about the grief and loss, and it helped me understand the **frame of mind** that might prevent someone from coming to a meeting.

From my experience in the last 9 years, people who have night sky knowledge, are fluent in a local Indigenous language, and are willing to present to an audience are very **rare**. If you are so incredibly lucky to find such a person, work with them closely because you are helping preserve some of this knowledge. If you can find a person willing to present to an audience and to become familiar with the night sky, then work with them and you can learn together. Hopefully that person will reach out to Elders to find words or ways of interacting with the sky.

Figure out what the Nation needs and wants from your collaboration. There are going to be circumstances in which your goals are not aligned; recognize this when it happens and take a step back. If people ask you to help, do what you can. For example, I was nervous to present a program for Indigenous Peoples' Day by myself. I felt that I would be called out as a fake, an imposter. But my collaborator said that they don't have enough people for the events and that I am an ally: She is comfortable with my representation. I was honored of course. Happily, we did find a speaker in the end, but I was willing to **step in when asked**.

Often, people speak of Indigenous people in the past tense; it is crucial to avoid doing so. One of the main points of these collaborations is to show the vibrancy of Indigenous people today! **Be sensitive to cultural norms**. For example, it is common in my experience that Indigenous people in Wisconsin do not want to be photographed. Their reluctance to be perceived as a poster child of their Nation is understandable. Be aware that even people who grew up on reservations might not be fluent in their language, and this can be a source of discomfort or embarrassment. Introductions are very important: Leave your education or titles at the door

and instead focus on where you are from, who your people are, and your immediate family.

2. Collaboration with the Black Student Center, the Department of African and African Diaspora Studies, and Sociocultural Programming

As many of us do (for example, see Peterman et al., 2022), I noticed that Black/African American people were **not represented** in our public programs as well as one might expect given that the population of Milwaukee consists of 39% Black/African American people. In 2016, I asked for help from colleagues in UWM's Inclusive Excellence Center and received outstanding advice: Include programs about African skies and consider astronomical connections with Islam.

Subsequently, we reached out to UWM's Black Student Center, the Department of African and African Diaspora Studies, and the Sociocultural Programming office to collaborate and connect the planetarium with community partners. In 2017, we tried two free programs. To mark the beginning of Black History Month, Sociocultural programming sponsored "**Celebration of African Culture**," which included a speaker, food, live music and dancing, and stargazing at three different latitudes of Africa. With speakers from the Department of African and African Diaspora studies, we offered "**Under African Skies**" at the planetarium (Figure 4), 30-minute shows on Wednesdays during February with a speaker associated with a different African country every week and stargazing from that latitude. We have noticed that the programs we offer during Black History Month have a significant increase of Black audience members, some of whom are African American and some of whom are Africans working or studying here. Perhaps more importantly, when people become familiar with the planetarium, they come back for other programs too. We have continued offering these programs and, so far, we have had speakers from Algeria, Egypt, Ethiopia, Kenya, Malawi, Senegal, South Africa, Tanzania, and Uganda.

Figure 4 (above) by Nathaniel Schardin; Figure 5 (right) by Autumn Chandler Carroll

Over time, these programs have evolved to include opportunities to learn about the region's food, music, famous people, acclaimed novels, and personal stories to the extent that the guest speakers wish. These programs also build momentum in securing future speakers. Mohamed, an Algerian undergraduate student, invited an Egyptian UWM alumnus to attend and, after seeing the program, this guest was eager to talk about his country the following year. One of our early programs mentioned specifically Moshi, Tanzania, because we had images that one of my staff took while visiting. At the end of the program, an obviously moved audience member approached me to say that his grandmother lives in Moshi and he loved seeing his home stars. He ended up presenting on Tanzania for "Under African Skies" the following year! We have found that the African students, faculty, and staff at UWM love talking about their homeland. This, again, is an example of building capacity and collaborations; the more we continue to offer this programming and work with community members, the more the word spreads to people who are interested or see that we are making a concerted effort and want to participate.

Benefits

One can offer more support and visibility to Black people in our communities by offering opportunities to co-present in our planetariums. We have invited students, staff, faculty, musicians, and leaders to speak their stories, from a pastor and community organizer who builds connections between disparate Milwaukee groups to a Navy veteran who, after long work shifts in many places around the world, made time every day to center himself by looking at the stars (Figure 5).

Challenges and Suggestions

African Americans and African immigrants may experience racism in similar ways but can also have fundamentally different experiences depending on their families' educational and economic situation. It isn't safe to assume anything about anyone's background. Share some of your own experiences in life and find things you have in common. As an immigrant who grew up on a different continent, I can find common threads with people who grew up

elsewhere: being homesick, feeling confused at times, and experiencing joy remembering some of the experiences I have had. As a person who is passionate about what I do, I can find common threads with people who are passionate about giving back to their community.

Diversify your sources of information, the people you surround yourself with, and what you read to get more insights on how other people live. For example, listen to this interview of Clint Smith, an African American writer and poet, who discusses many topics including how the history of slavery is distorted and how it still affects people now: *https://www.npr.org/2023/03/29/1166783252/in-above-ground-clint-smith-uses-poetry-to-confront-the-legacy-of-slavery.* If you don't have time for all of it, search for the piece called "Gold Stars" which talks about the experience of being an African American dad. Unless you are an African American parent, you might be surprised.

3. With the Muslim Student Association and the Milwaukee Muslim Women's Coalition

I grew up in Greece, a predominately Christian country, and indeed, because of the complicated history of being occupied by the Ottoman empire and the current uneasy relationship of Greece with Turkey, I became aware of how ignorant I am of Muslim traditions. My eyes were opened by friends from Senegal, a predominantly Muslim country, especially when I visited their welcoming country. Since 9/11, being a Muslim in the US (and many other parts of the world) has clearly been challenging. I felt the planetarium could help in making more people in our community see Muslim people for who they are: peace loving, creative, and a diverse group. To showcase this, we recorded UWM Muslim international students saying their name, where they are from, and how to say "hello" in their language.

The aforementioned "Under African Skies" programs did involve a predominantly Muslim country from North Africa: Algeria. The presenter, Mohamed Maache (Figure 6), was so interested in presenting at the planetarium again that we co-created a weekly series called "Arabian Nights" (Figure 7) with the help of Lina from UWM's Muslim Student Association. The program involved two students talking about their cultures (Algerian and Palestinian), contributions of scholars to the field of astronomy, and pointing out various stars with Arabic names. Every week, Mohamed and Lina offered the audience tea and homemade sweets. I suspect that many people in the audience had never had that kind of interaction with a young Muslim man or woman. To further emphasize science contributions, we collaborated with the Milwaukee Muslim Women's Coalition to produce a live program "Exploring Islam: Under the Stars."

Benefits

I have become a better teacher because of this collaboration. For example, when I was teaching "Searching for Life in the Cosmos," I noticed that a group of female Muslim students were somewhat reluctant to engage with the material in the course because they were not sure if the notion of extraterrestrial intelligence was sanctioned by Islam. When I was able to find readings that showed that the Quran embraces the idea of finding life beyond Earth, the students' attitudes changed markedly.

As another example, paying attention to when Ramadan begins and ends helped me avoid the embarrassment of bringing food to a daytime class that some people cannot eat. One of my Muslim students is a member of the Rohingya ethnic group and mentioned how gratifying it was to have a teacher who knew about Ramadan.

Challenges and suggestions

Not all people who come from predominantly Muslim countries are devout Muslims, just as not all people who come from predominantly Christian countries are devout Christians. Many people who feast around Christmas might be observing a cultural celebration rather than a religious one. The same is true of people who grew up surrounded by Muslim traditions. My recommendation is to follow the lead of the person with whom you are talking.

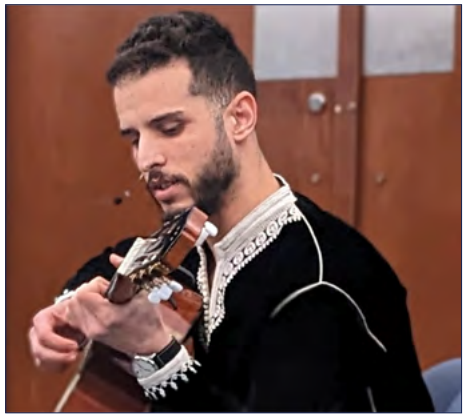

Figure 7 (top) by Nathaniel Schardin; Figure 6 (above) by Jean Creighton.

Conclusion

Because of these rich collaborations, I am more likely to read more about and participate in diversity, equity, and inclusion efforts. I have made mistakes, to be sure, but I have learned to dust myself off and climb back on. As time goes on and you become wiser, you are likely to build trust and meaningful relationships with a broader group of people, which ultimately enriches your personal and professional life.

This work is not without challenges. Finding people for your team with the right personality for collaborations is crucial; they must be good listeners, ask questions respectfully, and have the humility to learn from others. Seek collaborators who value the knowledge and skills that you bring and give you the benefit of the doubt if there is a misunderstanding.

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INCREASING INTEREST IN POLAR SCIENCE FOR GENERAL AUDIENCES THROUGH A LIVE, INTERACTIVE PLANETARIUM SHOW

By A.J. Balatico, College of Education, University of Washington

Abstract

Science museums are important informal science learning environments which have the potential to shape public discourse around topics such as climate change. Planetariums, which have traditionally provided projected, observational experiences to explore topics in astronomy, have evolved to engage different areas of science in live interaction with planetarium staff. The current study analyzes audience experiences of a planetarium show about polar science and climate change, Earth: Pole to Pole, designed jointly by Pacific Science Center and the University of Washington's Polar Science Center. Post-show survey results from general audiences indicated that over 90% of respondents felt that they learned either "some" or "a lot" about polar science, with a moderate increase in interest observed in all subgroups analyzed, but this increase was especially high amongst female respondents.

Introduction

Science is a collaborative enterprise, and learning about the newest scientific findings can be facilitated through supportive environments that provide feedback and foster interest (Bell et al. 2009; Meltzoff et al. 2009; Pea 2004). Science museums provide publicly accessible informal science learning environments outside of schools and universities, reaching audiences who can explore their own interest in science at their own pace. In order to increase engagement, and thus, increase science learning, many science museum features have become staffed so that audiences may interact with a knowledgeable expert who can respond to questions or make recommendations to other exhibits (Fraser et al. 2012; Lantz 2011; McCallie et al. 2009; Small and Plummer 2010). Specifically, live planetarium shows presented by staff provide opportunities for audience members to ask questions during the presentation, allowing staff to improvise from the scripted material. The role of the science museum to present scientific facts with social consequences becomes highlighted here because the implicit message of the current show revolves around climate change, a topic which is politicized in the United States due to its ties to economic regulation and governmental policies. Thus, science museums are cautious about how they convey scientific facts related to climate change (Cameron, Hodge, and Salazar 2013). However, the presentation of scientific facts can lead to conceptual change, spur interest in the natural world, and encourage audience members to learn more about science and how research is conducted.

Science museums linked to the National Science Foundation's Portal to the Public Network have also increased their partnerships between scientists and their research institutions, providing a venue to communicate current research findings, practice presentations for general audiences, and to provide non-scientist museum staff feedback about research findings and how research is conducted (Selvakumar and Storksdieck 2013).

In 2021, the Intergovernmental Panel on Climate Change reported the unequivocal human influence of warming trends in Earth's atmosphere, oceans, and land, the effects on the cryosphere, or Earth's frozen water, and the biosphere, or environments on Earth where life exists (Masson-Delmotte et al. 2021). This report uses historical climate trends to suggest that human activity is linked to observed extremes that cause more intense storms and longer heatwaves, as well as both heavy participation and droughts. The polar regions have an extremely important function of regulating the Earth's climate, yet human activity and increased greenhouse gas emissions are contributing to irreversible warming trends and increases in the frequency of rare events such as ice-shelf collapse and reversals of oceanic and atmospheric circulation.

The current study was designed to investigate the effects of a live, interactive planetarium show on learning and interest related to polar science facts and how polar science research is conducted (Stern

and Sturgeon 2017), expanding upon previous research through Pacific Science Center's Portal to the Public program (Selvakumar and Storksdieck 2013), whose goals were to improve science communication directed to the general public. The planetarium show studied here, Earth: Pole to Pole, was designed to explore the capacity to create a show for general audiences of Pacific Science Center (PSC) in Seattle, Washington.

Research Questions

The current study addresses the following research questions:

What did audience members learn from the polar science planetarium show?

How did this planetarium show influence audience members' interests in learning more about the polar sciences?

What features of the show were most engaging to audience members?

Literature Review

Communicating Science to the Public

Science museums, as informal learning environments, are poised to facilitate public dissemination of scientific facts as well as engender civic science literacy by informing audiences' identities, interests, and ethical judgments while making connections across scientific disciplines (Bell et al. 2009; Meltzoff et al. 2009).

The quality of informal learning environments is highly variable and far from a systematic contributor to the public's scientific understanding (Falk and Needham 2013). Internet sources of information are competing for the market-share of audiences, and adult admission rates to informal science learning venues such as museums, zoos, and aquariums have declined relative to the growing population of the United States (Besley 2015; Miller 2010; Rosenthal 2020). Rather than focusing on persuading audiences to believe a particular point of view, science museums can communicate information about natural and technological phenomena, ethics, funding structures, and timetables of impact for audiences of public stakeholders to form their own judgments about a particular topic (Bubela et al. 2009; Nisbet 2009).

Climate Change. Hamilton (2015) suggested that educated individuals may be better equipped to find information that supports their existing views on climate change but may lack basic factual information about geography or what factors contribute to climate change. Although some facts, especially measurements of temperature, remain uncontroversial, others, such as the relative rates of carbon dioxide emitted from human sources compared to naturally occurring sources, are most related to one's established views on climate change (Corner, Markowitz, and Pidgeon 2014). In order to change public understanding, it is important for the science museum to present facts unencumbered by judgments held by the general public.

Planetariums as Science Learning Environments

Planetariums are common features to science museums, which can help audiences learn in a novel, versatile environment that combines elements of theater and classroom settings. This combination of familiarity and novelty makes planetariums more memorable, thus making the experience more conducive to informal science learning when expectations before the visit have been established (Plummer and Small 2018).

Lantz (2011) outlined the increasing access to high sensory realism in planetariums, showing that the number of publicly accessible planetariums had surpassed other large format screens in the decade preceding the study, with over 700 publicly accessible planetariums in the United States; now the number of planetariums has been reported at 1,600, including portable and university planetariums (Faherty et al. 2019). The ease of importing new datasets and the ability to encourage audiences to make observations and predictions make the planetarium environment a shared computer simulation (Bell and Smetana 2008; Faherty et al. 2019; Fraser et al. 2012).

Yu et al. (2015, 2016) show that the presentation of content via an immersive planetarium leads to higher performance on astronomical content knowledge tests and retention for college undergraduates compared to students who received instruction without visuals or groups who received instruction by flat projection screens. Likewise, Brazell and Espinoza (2009) reported in a meta-analysis that K-12 student audiences retained information better through observational, participatory presentations when the presenter asked audience members to observe a certain location in the planetarium compared to when the presenter simply provided general information. Additionally, the meta-analysis found that the effect of a single viewing of a planetarium was larger than multiple viewings, suggesting that the novelty of a planetarium visit may make the experience more salient to audience members. K-12 audience members also have higher expected learning outcomes compared to college students (Brazell and Espinoza 2009).

Though the planetariums offer an immersive environment with positive effects on learning about astronomy and earth sciences topics such as moon cycles and lunar surface features (Brazell and Espinoza 2009; Plummer and Small 2018) or Earth's seasons (Yu et al. 2015), public planetariums are innovating by expanding the repertoire of science content which can be presented. Sherin et al. (2017) used live, interactive planetarium shows for collegiate audiences on the topic of Einstein's theory of relativity. Rather than a recorded projection, these shows were presented by planetarium staff who were able to respond to technical audience questions, especially to clarify concepts before proceeding. By guiding the course of the show, the presenter can contribute much to the audience's retention of content and satisfaction over other types of lectures or media-based delivery (Lantz 2011; Small and Plummer 2010).

Summary of the Research Literature and Limitations

Science museums, which communicate complex, and sometimes

controversial, science topics have an important role in shaping public discourse. However, they often compete against many other activities and more convenient sources of information, such as Internet and social media sources. In order to continue to improve their reach and engagement to audiences, science museums are now beginning to adopt new features and better learning scaffolds, such as incorporating live presenters into their exhibits. Audience feedback for improving these new additions provided an opportunity for researchers to find out what audiences are most interested in learning and how they are engaged with these exhibits.

Though many studies have been conducted with K-12 and undergraduate audiences with astronomical and Earth sciences, the researcher did not find studies related to the learning of general audiences in interactive planetarium settings for polar science, a topic which is not typically associated with planetariums. There is also limited information in the literature about disaggregated subpopulations such as race, ethnicity, and gender. The current study addresses these gaps by analyzing if measures of learning and interest increase after the planetarium show for the various subpopulations present in the sample of respondents.

Methods

Development of the Polar Planetarium Show

In July 2018, Pacific Science Center (PSC) in Seattle, Washington added *Earth: Pole to Pole* to its repertoire of live, interactive planetarium shows. The development of the show was funded by a grant from the National Science Foundation. The lead planetarian and the Principle Investigator, a polar scientist at the University of Washington's Polar Science Center (PSC), developed the scripted polar science content for the *Earth: Pole to Pole* planetarium show for general audiences.

Throughout the year, the show was updated to accommodate new datasets and visualizations. The motivation for designing the show was to inspire greater public interest, appreciation, and enjoyment of science and to encourage K-12 students to consider careers in STEM fields. The content of the show was selected to impart awareness of the Earth's polar regions and their role in global climate and to extend the existing collaborations between these Seattle-based public institutions (Stern and Sturgeon 2017).

From 2006 through 2020, PSC and the University of Washington held an annual Polar Science Weekend in March to incorporate current polar science research into PSC's programming (Stern 2013). Under the Portal to the Public project, PSC staff focused on developing face-to-face interactions between scientists and visitors and included science communication training for scientists. Although this project resulted in positive engagement, one limitation is that scientists cannot devote all their time to outreach, so those face-to-face interactions were relatively infrequent. Thus, PSC has designated some of its staff as "Interpretive Science Educators" focused on producing and performing live presentations for audiences throughout the museum floor and venues such as the planetarium.

The Interpretive Science Educators piloted the Earth: Pole to Pole planetarium show in spring and summer of 2018. Additionally, to reach a larger public audience with current scientific research, polar scientists and graduate students presented short sections on current research after the normal scripted content for special events held at PSC. This model of pairing scientists and museum staff for developing live shows has been disseminated to other members of the Portal to the Public National Network to expand the opportunities they offer their guests to connect with current science. This results in more public exposure for current scientific research than if the scientist alone were to make the presentations, which would occur only a few times per year.

The Willard Smith Planetarium at PSC is 40 ft wide, accommodating up to 40 audience members at a time. The Digitalis projection system allows rapid updates for new content such as new datasets or images to be implemented into shows. The planetarium staff included six Interpretive Science Educators capable of presenting the scripted live show.

Different planetarium shows were offered from noon to closing, and Earth: Pole to Pole was the only non-astronomy show, typically presented once per day. Shows last between 30 and 45 minutes.

Public showings of Earth: Pole to Pole included 493 general audience shows, 12 "Meet a Polar Fellow" shows, 11 school group shows, and 5 Polar Science Weekend shows, totaling 13,701 attendees (Davis-Unger 2020). On average, 28 guests attended each general audience show from December 2018 to March 2020.

Show Content

As audience members find their seats, video footage of the icebreaker U.S. Coast Guard Cutter Healy travelling off the coast of Alaska is projected. At the start of the show, the presenter discusses planetarium rules, safety information, how the show was created, and how audience members can participate and provide feedback. The Healy then docks in Seattle, and the planetarian pulls up a digital model of the Earth, focusing on the North Pole. Historical trends for sea ice and ocean temperatures are presented as heatmaps based on satellite datasets. Computer generated models of the Earth in orbit around the sun allow audiences to visualize seasonal changes. Photography and video imagery of onsite polar vessels and research outposts supplement the other visuals.

Though the focus of the show is climate change on the surface of the Earth, a segment during the first half of the show describes Earth's orbit around the sun as well as the Earth's axial tilt. The information described in this segment serves as an anchor for concepts later in the show, including the seasons and the etymology of the Arctic regions corresponding to Ursa Major and Ursa Minor. The planetarian may then zoom in on either the North or South Pole, depending on audience choice, on either the winter or summer solstice, simulating

extremes in day or night at the respective pole. After viewing datasets which show the rate of Greenland and Antarctica's melting land ice, water displacement and sea level rise, as well as oceanic and atmospheric currents and temperatures, the planetarian transitions back to Seattle, landing portside on the Healy.

Throughout the course of the study from 2018 to 2020, new and updated datasets were incorporated in response to audience interests and included the most recently collected climate data. The video and photographic footage used in the show included images aboard the Healy and an Alaskan research outpost to provide examples of where polar research is conducted. All of the other imagery is rendered by planetarium software, either as a computer-generated model or as a visualization of climate data. The script for the show does not take a particular stance on climate change explicitly, but rather presents a body of evidence to show historical trends in climate data such as decreasing Arctic sea ice.

Instrumentation

The survey was designed by the research and evaluation team to address questions pertaining to the goals of the project (for a copy of the survey, please email the author). Previous studies have been conducted at this planetarium, and the formatting and phrasing of questions were adopted with general audiences in mind so they can be filled out in less than five minutes. For ease and readability, all Likert-items were positively worded with a scale from 1 to 4. There was one short-answer fill-in-the-blank text response as well as questions related to previously going to this planetarium and being a member of PSC. The survey items were designed to ask audiences about their own assessment of their learning of polar science after seeing the show as well as to gauge their interest in polar science, what and how much they learned about the show's content, their desire to continue learning about polar science, and how much they liked the show.

The survey was two pages, front and back. For each showing, only eight surveys on clipboards spread throughout the planetarium were available to the audience.

Data Collection

Initially, a pilot research project used a sample of 120 surveys collected between December 8, 2018, and April 1, 2019. The planetarium show continued until March 12, 2020 when PSC closed due to the COVID-19 pandemic, and 674 total surveys, including those in the pilot, were collected by an external evaluation team funded by the grant (Stern and Sturgeon 2017, Davis-Unger 2020). The summative evaluation focused on descriptive statistics of survey item responses and included a separate set of open-ended questions for guest scientists to reflect on how they presented their research to public audiences. The current study differs from the summative evaluation because it asked different research questions about what audiences learned. The researcher used the 674 surveys collected from December 2018 to March 2020 to conduct inferential statistics on questions related to differences in response by age, race, gender identity, and planetarium membership.

Analysis

To determine what audiences learned about polar science, how the planetarium show changed their interest in polar science, and which show features were most salient, descriptive statistics of survey items were conducted in SPSS alongside qualitative coding of the short response item.

Quantitative Analysis. Student t-tests were used to compare variables such as pre- and post- show responses on audience interest in polar sciences. Analyses of age-group, gender, racial and ethnic identity, and Science Center

Table 1

Frequencies of Respondent Demographics and Pacific Science Center Experience

Gender (*n* = 544)	*n*	%
Male	201	36.9
Female	332	61.0
Identify Differently	11	2.0

Race / Ethnicity (*n* = 520)	*n*	%
Hispanic / Latinx	78	15.0
Black / African American	22	4.2
White / Caucasian	337	64.8
HI / Pacific Islander	11	2.1
Asian	96	18.5
American Indian / AK	11	2.1
Other	29	5.6

Age Ranges (n = 528)	*n*	%
under 8	12	2.3
8-10	69	13.1
11-13	44	8.3
14-17	33	6.3
18-24	73	13.8
25-34	114	21.6
35-44	99	18.8
45-54	44	8.3
55-64	24	4.5
65+	16	3.0

	n	Yes	%Yes	No	%No	Not Sure	%NS
(1) Have you been to a planetarium show at the Pacific Science Center?	669	176	26.3	470	70.2	23	3.4
(9) Would you recommend this planetarium show to a friend?	580	489	84.3	12	2.1	79	13.6
(10) Are you a member of the Pacific Science Center?	546	126	23.1	407	74.5	13	2.4

Note: Gender, Race/Ethnicity, and Age Range data were responses to the optional "Tell us About Yourself" section. For race / ethnicity, respondents could select multiple identifiers. Numbers in parentheses (bottom rows, left) indicate the survey item.

Table 2

Descriptive Statistics of What Respondents Learned – Question #3 of Survey

Survey Item	Strongly Disagree (1)	Disagree (2)	Agree (3)	Strongly Agree (4)	*n*	*M*	*SD*
After seeing this planetarium show, I know more about…							
the difference between sea ice and glacial ice	21 (3.2)	60 (9.1)	232 (35.1)	348 (52.6)	661	3.37	0.78
how changes in the Arctic are signs of global climate change	32 (4.8)	67 (10.1)	218 (32.9)	345 (52.1)	662	3.32	0.84
polar ice (e.g., where it is found, how it forms)	16 (2.4)	58 (8.8)	286 (43.3)	300 (45.5)	660	3.32	0.73
where the Arctic and Antarctic are located	50 (7.6)	45 (6.8)	224 (34.0)	340 (51.6)	659	3.30	0.90
research being conducted in the area of polar science	21 (3.2)	76 (11.4)	284 (42.8)	283 (42.6)	664	3.25	0.78
the concept of displacement and how it applies to melting glacial ice	31 (4.7)	88 (13.2)	271 (40.9)	272 (41.2)	662	3.18	0.84

Note: Survey items are arranged from the highest mean to the lowest. Response percentages are in parentheses.

Table 3

Short Answer Responses About Most Interesting Topic Learned After Seeing the Show (n = 469)

Topics	Count	%	Example Response
Trends*	84	17.9	The range of ice volume in both poles throughout different months of the year
Ice and Water	61	13.0	The difference between glacial and sea ice
Concepts*	41	8.7	The basic connection/explanation for Glacial Ice making water levels rise.
Consequences*	40	8.5	Rapid decrease in polar stability due to global warming and carbon emissions.
Polar Regions*	29	6.2	The differences between north and south pole
Miscellaneous*	28	6.0	how it changes
Climate Change	24	5.1	About the climate change and how the ice is melting
Antarctica	19	4.1	How the Antarctic temperatures affect the whole globe
Currents	18	3.8	The effects on currents of the ice melting and refreezing
Polar Research*	18	3.8	the use of satellite images to study and communicate changes
Astronomy*	17	3.6	That you can find the North Star using the big dipper
Arctic	17	3.6	Arctic ice melt progress since 1990
Show Comment*	15	3.2	The program looks kinda old. Pixelated. I recommend more production films.
Sea Mammals*	14	3.0	That they put tracking devices on seals
Glacial Ice	8	1.7	Melting Glacial Ice adds water to Earth's overall system
Greenland	8	1.7	The amount of melting glaciers in Greenland
Sea Ice	8	1.7	The growing/shrinking and tracking of sea ice
Seasons	8	1.7	Honestly just getting a better idea how the poles work relating to seasons was fascinating
Fish*	6	1.3	The fish, arctic cod and how they live
Geography*	6	1.3	The monitoring of current in the Bering Straights and the flow to Antarctica and around the world

Note: Responses are from survey item 7 "Finish this sentence: "After seeing this show, the most interesting thing I learned about polar science is…" Each theme is specifically mentioned in the response because they were explicitly mentioned in the show. *=themes with multiple specific keywords or phrases within a response.

membership are important to distinguish which factors, if any, may lead to differences in responses. Analysis of variance (ANOVA) within and between participant subgroups, and paired t-tests comparing interests before and after the show, are used to address additional emerging research questions. Sidak post-hoc tests (Shingala and Rajyaguru 2015) were used to identify significant group differences, and standardized effect size differences between group means were calculated for Cohen's d. Response differences between members of PSC and non-members were also identified using Pearson's chi squared tests.

Qualitative Analysis. To explore what audiences learned, short answer responses to the prompt, "After seeing this show, the most interesting thing I learned about polar science is…" (n = 469) were coded into 20 specific topics or themes, determined by the researcher, based on the survey items and changing nature of show content at the time of the study.

Participants

The audiences at PSC are a self-selecting public sample. The optional "Tell us about yourself" appears in item 10, on the bottom half of the back of the survey; 544 of the 674 surveys completed (80.7%) provided this information. This section includes gender, ethnicity, age group, "Why did you choose to attend this planetarium show today?", and membership in PSC. The sample includes more female respondents (61.0%) compared to male respondents (36.9%). The largest racial and ethnic group represented is White / Caucasian (64.8%), followed by Asian (18.5%) and Hispanic / Latinx (15.0%). Close to three-fourths of respondents were not members of PSC.

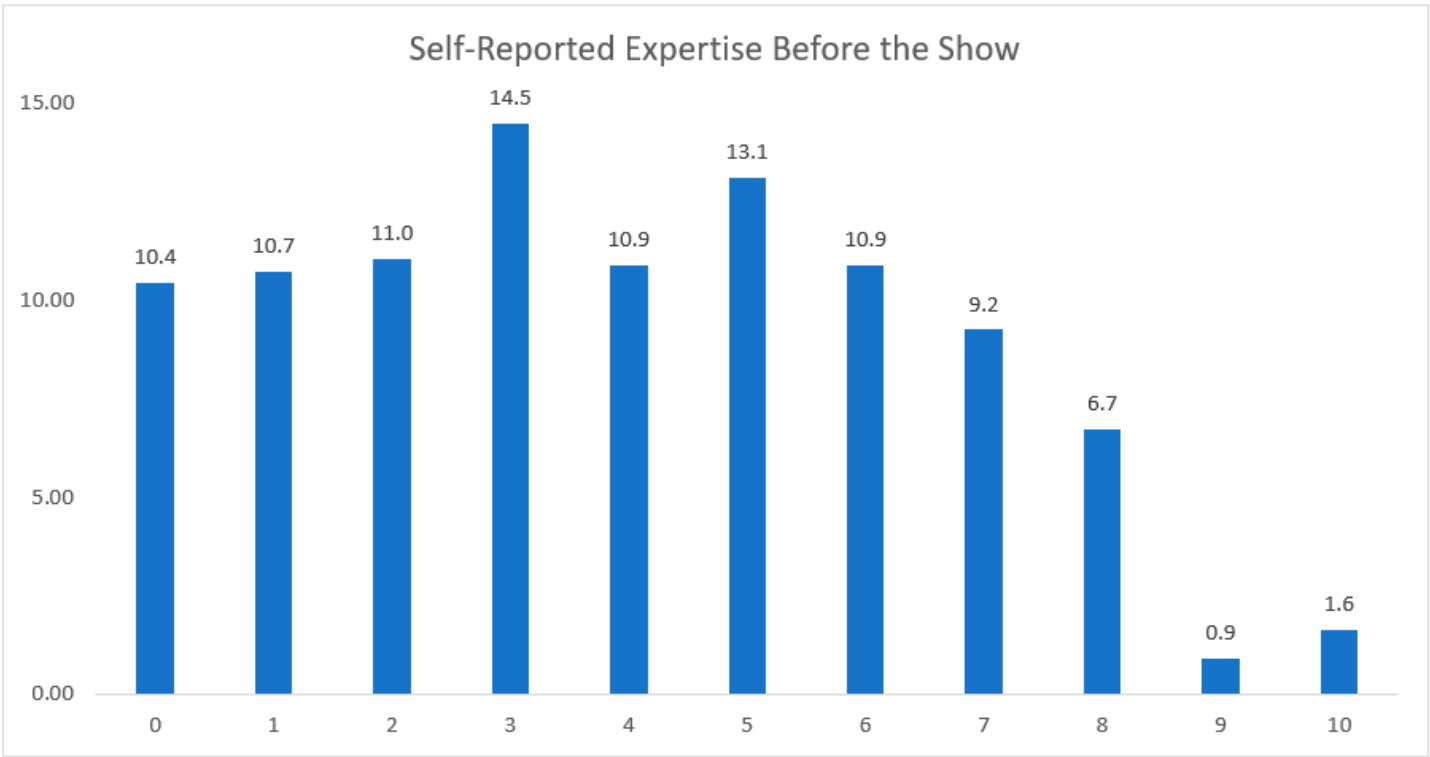

Figure 1. Responses to "When thinking about the topic of polar science, I consider myself a/an:" 0=novice, 10=expert (n=671, mode=3, M=3.93, SD=2.55).

About one-third of survey respondents were between the ages of 18 and 34, and about one-third were between 35 and 64. About 30% of the respondents (158 out of 528) were minors, and only 3% were 65 years or older (see Table 1 for a summary of respondent demographics).

Findings

Research Question 1. What Audience Members Learned from the Show

About 4 out of 5 audience members reported that they either agreed or strongly agreed that they felt they learned about the selected topics (See Table 2). The differences in means between items were not significant compared to the grand mean (M = 3.29, $p>0.05$) of the six items related to show content.

In order to see which topics audiences found most salient, short answer responses to the prompt, "After seeing this show, the most interesting thing I learned about polar science is..." (n = 469) were coded into 20 specific topics or themes (see Table 3). Nine themes included responses that explicitly mentioned synonyms like ice and water, climate change, Antarctica, currents, Arctic, glacial ice, Greenland, sea ice, and seasons. The topic of "climate change" included close synonyms such as global warming, and "seasons" mostly included references to summer and winter. Explicit mentions of Antarctica and the Arctic as well as glacial ice and sea ice were counted in the cases where only one of the "pairs" was mentioned in a response.

Eleven other codes were applied for responses involving multiple keywords or more complex relationships between other ideas. The highest counts were for "trends" (n = 84, 17.9%) where there was indication of changes over time based on climate or weather patterns at a location. "Concepts" (n = 41, 8.7%) referred to ideas that involved the cause-and-effect relationships between topics, such as ice melting or water displacement effects on sea level. "Consequences" (n = 40, 8.5%) indicated an anthropogenic cause of climate change, or an effect on humans and society. "Polar regions" (n = 29, 6.2%) identified both Antarctica and the Arctic, the North or South Pole, or used the words "polar regions" or "poles" in addition to another concept such as temperature, melting ice, or weather patterns. "Polar research" (n = 18, 3.8%) included references to specific technologies such as buoys or satellites or research vessels, such as the USCG Healy, which frames the introduction and conclusion of the show. "Astronomy" (n = 17, 3.6%) included references to stars or the Earth's relationship to the sun. "Geography" (n = 6, 1.3%) included specific locations mentioned beyond the Arctic, Antarctic, Greenland, and the polar regions.

"Sea mammals" (n =14, 3.0%) and "fish" (n = 6, 1.3%) were most likely to occur when a polar scientist specifically mentioned their own research in the show. Seals and narwhals were specific sea mammals mentioned, and Arctic cod populations were also mentioned in responses.

"Show comments" (n = 15, 3.2%) included feedback about the show, including the visuals used. "Miscellaneous" (n = 28, 6.0%) responses included those where the object of the response was vague with words like "it," or if the responses did not refer to a topic about the show. Interestingly, none of

Table 4

Descriptive Statistics of Respondents' Interest in Polar Science

Survey Item	Strongly Disagree (1)	Disagree (2)	Agree (3)	Strongly Agree (4)	*n*	*M*	*SD*
(5b) I am interested in learning more about polar science	10 (1.5)	45 (6.7)	328 (49.0)	287 (42.8)	670	3.33	0.67
(5c) I plan to share some part of what I learned with my friends and/or family	14 (2.1)	60 (9.0)	291 (43.6)	303 (45.4)	668	3.32	0.72
	Not at all (1)	Not much (2)	Some (3)	A lot (4)			
(4b) After today, how interested are you in polar science?	9 (1.3)	26 (3.9)	316 (47.4)	316 (47.4)	667	3.41	0.63
(2b) After seeing this planetarium show, how much do you feel you learned about polar science	12 (1.8)	41 (6.1)	323 (48.0)	297 (44.1)	673	3.34	0.68
(4a) Before today, how interested were you in polar science?	62 (9.3)	200 (29.9)	288 (43.0)	119 (17.8)	669	2.69	0.87

Note: Survey item numbers are in parentheses at left. For Likert responses, percentages are in parentheses.

Table 5

Descriptive Statistics of Respondents' Show Experience

Survey Item	Strongly Disagree (1)	Disagree (2)	Agree (3)	Strongly Agree (4)	*N*	*M*	*SD*
(7b) Having a live presenter guiding the show made it easier to pay attention	8 (1.4)	20 (3.4)	208 (35.9)	344 (59.3)	580	3.53	0.63
(7c) I felt comfortable asking the live presenter questions during the show	11 (1.9)	37 (6.5)	221 (38.9)	299 (52.6)	568	3.42	0.70
(5a) I am interested in seeing more shows like this one	12 (1.8)	49 (7.3)	285 (42.6)	323 (48.3)	669	3.37	0.70
(7a) The images used in this planetarium show were so real that I felt like I was in the Arctic	32 (5.6)	156 (26.9)	279 (48.1)	110 (19.0)	580	2.81	0.81
	I really didn't like it (1)	I didn't like it (2)	I liked it (3)	I really liked it (4)			
(8) How much did you like this planetarium show?	6 (1.0)	16 (2.8)	253 (43.9)	301 (52.3)	576	3.47	0.61

Note: Survey item numbers are in parentheses at left. For Likert responses, percentages are in parentheses.

Table 6

Reasons Why Audience Members Attended the Planetarium Show (n = 546)

Reasons	*n*	%
I like planetarium shows	300	54.9
The topic looked interesting	207	37.9
The time of the show fit with my schedule	183	33.5
I like live presentations	146	26.7
I thought my child/children would enjoy it	110	20.1
Other	77	14.1
I came with a school group	16	2.9

Note: Responses are from survey question 10. Respondents may choose all applicable options. Frequency is a tally count. Percentages are based on the number of audience members who responded with each reason; therefore, percentages will not sum to 100%.

the 469 responses included the word "science" except for one response desiring "Please present more balanced science concerning different opinions on climate change."

Research Question 2. Changes in Polar Science Interest

In order to gauge initial interest and self-evaluation of knowledge in polar science, respondents rated their level of expertise in polar science before seeing the show from 0 (Novice) to 10 (Expert) [Item 2a, n = 671, mode = 3, M = 3.93, SD = 2.55] (Figure 1). Though "3" was the mode (n = 97, 14.5%), 13.1% of respondents answered "5." The distribution from "0" to "7," excluding "3" and "5," was uniform with frequencies ranging from 9.2% to 11.0%. Only 2.5% of respondents answered "9" or "10" to describe their expertise.

Interest before and after the show was gauged with responses to "Before today, how interested were you in polar science?" and "After today, how interested are you in polar science" (see Table 4). Before the show, 60.8% expressed either "some" or "a lot" of interest in polar science, and 39.2% responded either "not much" or "not at all." In contrast, 94.7% were interested in polar science after the show. A paired samples t-test of these responses uses the mean and standard deviations of before and after show interest. There was a statistically significant increase in interest after viewing the show (M=3.41, SD=.633) compared to before the show (M = 2.69, SD =.869) [t(668)=80.193, p <

0.001, Cohen's d = 0.869]. Additionally, respondents were "interested in seeing more shows like this one" (90.9%, see Table 5) and planned to share some part of what they learned with their friends and/or family (89.0%, see Table 4).

Research Question 3. Salient Show Features

The features of most interest to the researchers were the show's imagery, having a live presenter, and being able to ask questions during the show (see Table 5). "The images used in this planetarium show were so real that I felt like I was in the Arctic" was the most divided with only 67.1% of respondents agreeing. However, 95.2% of respondents agreed that "having a live presenter guiding the show made it easier to pay attention" and 91.5% agreed they "felt comfortable asking the live presenter questions during the show." Overall, respondents reported that they liked the show (96.2%, see Table 5) and learned about polar science from it (92.1%, see Table 4).

Frequencies of reasons for coming to the show are presented in Table 6. The highest percentage of respondents (54.9%) indicated they liked planetarium shows. "The topic looked interesting" (37.9%) and "The time of the show fit my schedule" (33.5%) were the second and third most common responses. Only 2.9% of respondents (16 of 546) came with a school group.

Inferential Statistics

Although the descriptive statistics address the research questions about how audiences learned about polar science and climate change, how interested they were in polar science, and whether the show features affected how they learned, the researcher used inferential statistics to explore whether group differences existed in this sample of respondents. Two secondary research questions emerged during data analysis:

- What group differences, if any, lead to differences in learning and interest in polar science?
- What group differences, if any, lead to different responses related to audience experiences?

Pacific Science Center may attract audience members who are more likely to have a positive disposition towards science. Groups observed may have demonstrated different levels of access and interest to Pacific Science Center based on age, gender, race, and Pacific Science Center membership (see Table 1). Analysis of Variance (ANOVA) was used to identify group differences based on age, gender, and racial and ethnic groups and PSC membership.

Age. Participants reported which range of ages they belonged to instead of reporting their exact age. For the purpose of this analysis, participants were reclassified into minors under 18 and adults 18 and older. Adults had a higher interest in polar science before the show (n = 369, M = 2.80, SD = .799) compared to minors (n = 155, M = 2.42, SD = .946) [t(522) =4.698, p < .001]. After the show, adults still had a higher interest in polar science (n =369, M = 3.42, SD = .651) than minors (n = 155, M = 3.24, SD = .903) [t(522) = 2.010, p = 0.005]. However, a comparison of minors' reported interest before and after the show (Cohen's d = 1.07, r = 0.47) demonstrates a larger gain from seeing the show compared to adults (Cohen's d = 0.91, r = 0.41); that is, minors experienced a larger change in polar science interest after watching the show compared to adults.

About 41% of minors had previously attended shows at PSC compared to only 28% of adults. Minors were also less likely to agree with the statements "I am interested in seeing more shows like this one," "I plan to share some part of what I learned with my friends and/or family," but more likely to agree with "the images used in this planetarium show were so real that I felt like I was in the Arctic."

Gender. The disaggregated distribution of responses suggested that female and male respondents had similar levels of interests before the show, but different levels of interest in polar science after the show. Of respondents who rated their interest "not at all" or "not much" before the show, almost all females (131 out of 139, 94.2%) increased their interest to "some" or "a lot" after the show compared to only 55 out of 71 males (77.5%). Though males on average started at a higher baseline interest of 2.77 (n = 200, SD =.897) compared to the female baseline of 2.64 (n = 329, SD = .858), this difference was not statistically significant. Even though female respondents (n = 329, M = 3.43, SD = .544) rated their after-show interest about the same as male respondents (n = 200, M = 3.37, SD = .704), female respondents had a statistically significant larger effect size between the before and after-show levels of polar science interest (Cohen's d = 1.09, r = 0.48) compared to males (Cohen's d = .74, r = .35) because they were more likely to indicate an increase in interest after watching the show; the Cohen's d is calculated using the differences in means divided by the pooled standard deviations of the groups. Though both male and female groups show a medium effect size within their respective groups, the larger effect size r for females is closer to the threshold of 0.5, which is considered a strong effect (Rice and Harris 2005).

Taken together with the previous finding that minors had a larger growth in interest from before and after the show, female respondents under 18 were more likely to report lower interest before the show (n = 86, M = 2.38, SD = .972), but they had the largest change in interest after the show (n = 87, M = 3.33, SD = .641; Cohen's d = 1.28, r = 0.54) compared to male respondents under 18 (n = 57, Cohen's d = 1.00, r = 0.447), female adult respondents (n = 227, Cohen's d = 1.07, r = 0.474), and male adult respondents (n = 129, Cohen's d = .67, r = .313).

Race and Ethnicity. About one-third of White / Caucasian respondents (n = 334) have attended a planetarium show at PSC before, compared to only about one-fourth of respondents from other racial groups (n = 182). White / Caucasian respondents disagreed more with the statement "the images used in this planetarium show were so real that I felt like I was in the Arctic regions" (n = 334. M = 2.72, SD = 0.800) compared to other racial groups (n = 182. M = 2.99, SD = 0.775).

Respondents of an Asian background were more likely to have agreed with the statement "the images used in this planetarium show were so real that I felt like I was in the Arctic regions" (n = 96. M = 2.99, SD = 0.747) compared to other racial groups (n = 419. M = 2.78, SD = 0.808). Only 19% of respondents of a Hispanic or Latinx background (n = 78) had attended a planetarium show at PSC before, compared to about 34% of respondents from other racial groups. Although only 22 of the 540 respondents who self-identified their racial background were Black. Black respondents indicated a statistically significant higher rate of agreement with the statement "having a live presenter guiding the show made it easier to pay attention" (M = 3.73, SD = 0.456) compared to other racial groups (n = 495, M = 3.54, SD = .625).

PSC Membership. Approximately 23.1% of respondents were members, and 2.4% were unsure of their membership status. Chi-square tests reveal no significant differences in PSC membership patterns based on gender. However, membership rates were greatest for "under 8" at 64% and "8-10" at 40%. Adults aged 35 and over had a membership rate of about 29%. PSC membership did not reliably predict how respondents answered questions as there were no statistical differences between members and non-members.

Discussion

Planetarium capabilities to enhance audience experiences

The show was designed to convey the most current polar science research and climate change data through live presentation. Though the planetarium media uses computer generated graphics, satellite data, and projections of recent polar science datasets, the main feature was the interactive experience with the presenter. Only 56% of the audience found the imagery immersive, yet over 90% liked and learned from the show. This finding suggests that, for most people, image realism is not necessary to facilitate polar science content, though visuals can be helpful in conveying information related to astronomy and geography. Given that realistic imagery was not a strong predictor of how much audiences learned or enjoyed the show, planetarium staff may consider using exaggerated visual features such as heatmaps and low-flight orbital paths on simulated versions of the Earth in order to illustrate content clearly. Planetarium staff can make explicit transitions from anywhere in orbit to locations on the Earth's surface rendered in 3D computer graphics or as a projected map. Many of these transitions are improvised, allowing the audiences to see information from earlier sections of the show, thus customizing the experience.

Audience members choose to go to the planetarium at the scheduled time, and this planning becomes a way that visitors to PSC can select what they want to learn about. Over 90% of respondents generally agreed that the live presenter made it easier to follow and that they felt comfortable asking a question. Most audience members did not ask questions during the show but knowing that their participation is welcome and encouraged may have increased their satisfaction with the show. Though engagement throughout the show was not directly measured, emotional content was expressed in some of the short response items, indicated by sharing a fun fact, and commenting on how the findings of polar science affect society.

There is no current data about repeat visitors, and it is not intended that an audience member would see the show again in the immediate future, though the planetarium presenter indicates that the show is in development and audience feedback will be used. When asked whether they would like to see more shows like this one, 90.9% of respondents agreed. The data show high interest in polar science after the show – over 90% agreed they would like to learn more about polar science – so PSC may consider expanding exhibits to include polar science content beyond Polar Science Weekend.

Demographic differences in polar science interest

One potential explanation of the difference in baseline interest between adults and minors may be the levels of exposure throughout their lives to polar science content for adult audience members. Pacific Science Center membership nearly tripled the probability of a respondent having previously visited this planetarium. This suggests familiarity of the planetarium features among PSC members, though this group rated the amount they learned after the shows similarly compared to non-members, regardless of whether they had previously gone to this planetarium. The finding that female respondents report a greater interest in polar science after the show is important because of female underrepresentation in STEM fields. Identifying ways to increase awareness and interest in STEM is a motivating factor for the work of the Portal to the Public program and Earth: Pole to Pole show, and despite the higher reported interest in female respondents, the overall positive effects for most audience members is clear with over 90% indicating they would like to learn more about polar science.

Conclusion

The results of the show are promising in increasing audience interest in polar science, especially female audience members who have been historically underrepresented in STEM professions. The contents of this show are freely available internationally online through Uniview and Nightshade planetarium software communities, or the planetarium media files may be requested from PSC. Modern planetariums can import updated datasets and relevant show information with a rapid turnaround, allowing them to explore different science topics beyond astronomy. The interactive nature of the show with a live presenter allows audiences to engage in topics of interest to them; about 9 out of 10 audience members felt comfortable asking questions and that the live presenter facilitated their learning.

Follow-up experiences to supplement this planetarium show, alongside periodic events such as Polar Science Weekend, can allow focused engagement in science topics of local and global interest. The researchers

hope the growing and continued collaboration between science researchers and science museums will help to create new and relevant learning experiences for members of the public.

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FOUR NEW PLANETARIUM TO OPEN IN FRANCE IN 2023

By Milène Wendling, Emmanuel Laisné, Fabrice Fillias, Julien Malaval, & Didier Schreiner

Figure 1: Vulcania planetarium building standing in the middle of the "Chaine des Puys" volcanoes © Vulcania

Abstract

Planetariums are certainly among the most fascinating places to communicate astronomy to the public. In 2023, they are celebrating their 100th anniversary. But, since the first one was built in Jena, the word of planetariums has grown to reach around 5,000 planetariums worldwide. Among them, 190 have been established in France, since the very first one in 1937 in Paris during the world's fair. This year, 2023, is expected to be stimulating, particularly in France, as four major planetariums are opening their doors hoping to reach new audiences.

It has been a century since the first planetarium was built, a century of humans having a glance at the mysteries of the Universe, and a century of spreading scientific knowledge developed by research teams from all over the world.

Planetariums are certainly among the most fascinating places to communicate astronomy to public. In 2023, they are celebrating their 100th anniversary. But, since the first one was built in Jena, the word of planetariums has grown to reach around 5,000 planetariums worldwide.

Among them, 190 have been established in France, since the very first one in 1937 in Paris during the world's fair. This year, 2023, is expected to be stimulating, particularly in France, as four major planetariums are opening their doors hoping to reach new audiences. This is completely unprecedented in the French planetarium community! In Clermont-Ferrand, Douai, Strasbourg, and Grenoble, teams are working hard to continue this collective work of popularising astronomy to ensure that it reaches an ever-growing number of citizens....

Birth of a planetarium: a long-term project coupled with strong convictions

In the vicinity of Clermont-Ferrand, Vulcania was born from a project first called "Volcania," imagined at the end of the 1980s by two French volcanologists, Maurice and Katia Kraft. But it took more than twenty years to see the site finally open on 20 February 2002. Standing by the volcanoes of the *Chaîne des Puys*, Vulcania park is now the property of the Auvergne-Rhône-Alpes regional council but is operated by a semi-public company called *Volcans*.

From the very beginning, the park's purpose has been to disseminate the most recent knowledge in volcanology andEarth and space sciences. In 2023, the opening of Vulcania's new planetarium will reinforce space-related themes and forge links between different themes, because understanding Earth often means looking up to the sky and trying to understand how our Universe works.

For a great project to come to existence, stars often must align. Planetariums are no exception to this statement, and so does Douai's planetarium located north of France. As in Clermont-Ferrand, the project was initiated by two people, two members of the astronomy club hosted by Douai's youth and culture centre, Frédéric Kwasnik and Valérie Dubuche. Their arguments and enthusiasm convinced the elected representatives to take an interest and equip the region with a structure dedicated to space sciences and astronomy. It is a centre intended both for schoolchildren and individuals from the city but also seen as a way to enhance tourism. Within a few years, what was just an idea came to birth. Orionis has been welcoming visitors since its opening days on the 13 and 14 May.

In Strasbourg, the new planetarium is part of a twofold commitment to continuity: perpetuating the activities of the first planetarium installed in 1982 in the Astronomical Observatory by the astrophysicist Agnès Acker and reinforcing the objectives of the University of Strasbourg in its

long-standing commitment to sharing scientific knowledge. More than 40 years of communicating astronomy, as close as possible to research, have left their mark on the city, the region and its public. In 2009, during the International Year of Astronomy, Strasbourg's University decided that they would be building a new planetarium. 14 years later, the planetarium is finally opening its doors.

In the autumn of 2023, in Pont-de-Claix (Grenoble Metropolis, French Alps), it will be Cosmocité's turn to open its doors to the public for a dive into Earth, space, and environmental sciences. Here again, we find the concretization of an idea that raised nearly ten years ago: the idea of a place conceived by and with Grenoble scientists.

Supported by Grenoble Metropolis and entrusted to a French and Canadian team of architects and scenographers (Arcane Cardin Jullien), the project has given new life to the *Grands Moulins de Villancourt* site, a former flour mill highlighting the city's industrial and technical heritage. Hand in hand, scenographers, scientists, and the team of *Territoire de sciences* - a new public organisation established to enhance cultural cooperation between different stakeholders - have put together a cultural programme at the junction between science education and entertainment with the aim of welcoming 55,000 visitors a year, of which almost a third are schoolchildren.

Figure 2: Cosmocité from Thomas Pesquet square © Territoire de sciences

Cultural facilities equipped with state-of-the-art technology

Each of these planetarium projects is unique, but they are all part of a local ecosystem and offer activities beyond their projection dome. Thus, Orionis completes the offer of the cultural and scientific pole of Douai urban area. It joins *Arkéos*, an archaeological park, and its tavern from the middle ages (with which it shares car parks and catering facilities), and Legendoria, a venue for the creation of artistic shows dealing with tales and legends. This dynamic will continue as a new museum facility will soon see the light of day: an old books and etchings museum.

In fact, Orionis is:

- a planetarium with a 15.5 m diameter dome equipped with 12 laser video projectors for an overall resolution of over 10K. All of this was deployed by RSA Cosmos | Konica Minolta
- an observatory equipped with a 432 mm diameter telescope and a 100 mm solar telescope, managed by the astronomy club of Douai's youth and culture centre, which offers night and day observations depending on the weather conditions
- 3 scientific practice rooms to offer activities where manipulation, experimentation, and thinking are at the heart of the teaching process
- a temporary exhibition space of 200 m² which will host a first exhibition on meteorites and impact craters

In Grenoble, Cosmocité is also part of a rich cultural ecosystem. Located in a working-class area, it aims to bring science closer to audiences that are not very familiar with it. It will thus have to be integrated into the life of a metropolis where science and technology are widely present. For this purpose, the place will benefit from a 2000 m² space that integrates:

- two permanent exhibition areas of 300 m² dedicated to Earth, space, and environmental sciences
- a 200m² modular space for young people (3 to 7 years old), designed to host temporary exhibitions and practice rooms
- a planetarium with 80 seats and a 13m dome equipped by RSA Cosmos | Konica Minolta
- an immersive and interactive room with two 12 m by 6.75 m projection surfaces (wall and floor), deployed by RSA Cosmos | Konica Minolta and the digital art studio Theoriz
- a lookout point offering a view over the city and the surrounding Alps

Figure 3: Vulcania planetarium entrance hall © Vulcania

Vulcania's planetarium opened its doors on 29 March, 2023, for the launch of the 2023 season. It is part of a 0.57 km² site. With a 22 metres diameter dome and 306 seats, it will be one of the largest planetariums in France. Equipped with 12 laser video projectors with a 10k resolution and 7.1 sound for optimal immersion, it operates under the Sky Explorer simulator developed by RSA Cosmos | Konica Minolta.

Figure 4: Strasbourg planetarium building in the very heart of the campus © M. Holdrinet - Jardin des sciences

But the planetarium is not limited to the dome, and includes several buildings that radiate out from an entrance hall.

- *Laniakéa* - an information and multimedia space
- 4 practice rooms (Helios, Orion, Sirius and Vega), where the general public or schoolchildren can attend workshops led by the park's science communicators
- an introductive space giving access to the dome and allowing the viewing of a dedicated projection
- the projection dome called Astrodome

Among the French planetarium community, Strasbourg's has a distinction; it is the only planetarium hosted by a university. It is located in the *Jardin des Sciences* at the very heart of the historic campus. It is a true cultural district where the planetarium, museums, and gardens coexist and where people come to observe the stars, admire the heritage collections, take part in workshops and guided, meet scientists, or simply stroll through the gardens. Amongst conferences, exhibitions, events, festivals there is something for all tastes and all ages.

The planetarium team is part of the University of Strasbourg's scientific culture department, which has 40 staff members and runs the facility.

The new planetarium project consists of a double building (1,000 m^2) and rehabilitated gardens (5,000 m^2), designed by architects Frenak and Julien that includes:

- a general reception area for the *Jardin des sciences* with a café, shop and waiting area
- a room for educational activities related to sciences
- a 15 metres diameter planetarium, inclined at 18° with 138 seats, equipped by Evans & Sutherland (a Cosm Company)

Question, amaze, entertain to diversify the public

In Strasbourg, the project is conducted in close collaboration with Strasbourg Astronomical Observatory, a leading scientific research laboratory with a staff of 80 people. The observatory has a rich scientific heritage and unique collections, such as the 3rd largest telescope in France (49 cm diameter) located in an emblematic building, a Coronelli globe dating from the XVIIth century, old astrolabes, etc. A discovery path and observations are offered to visitors, led by the team of the *Jardin des sciences*. The link to scientific research is strengthened by the possibility of displaying research data on the planetarium dome. These data are hosted by the CDS (Strasbourg Data Centre), which is widely known and recognised in the science community. Visitors, young and old, will hence be able to visualise data used by scientists, a way to understand scientific approach and question the world. These actions are integrated into a rich and stimulating programme.

As Vulcania's Planetarium is located within the park, it is integrated with the overall offer made to the public. Visitors pay their entrance fee to the park and have full access to its activities, including those of the planetarium.

A visit to the park used to take 6 to 8 hours on average but has now been extended by more than 3 hours with new activities. These include two planetarium shows: two live sky discoveries with science communicators and workshops dedicated to a general audience. In addition to these activities, workshops have been created for students. The planetarium is thus part of the park's development plan, which aims to become a holiday destination.

In Douai, the diversity of cultural facilities spread over the city gives the opportunity of mixing space and human history. They are giving visitors keys to understand where and when they are standing in the Universe and time. As we all know, looking at the remains of mankind or looking deep into the starry sky is always a wonderful journey into the past. For the elected officials, Orionis, since it is dedicated to space sciences and astronomy, is well designed for school audiences. But they also wanted the facility to strengthen the region's tourism offerings and its attractiveness to help boost its economy. Hence, the requirement for accessibility to all audiences, whatever their level. Still, sciences remain at the heart of the

Figure 5: Evolution, an immersive experience developed for Cosmocité's interactive room © Grenoble Alpes Métropole - Clara Goubault

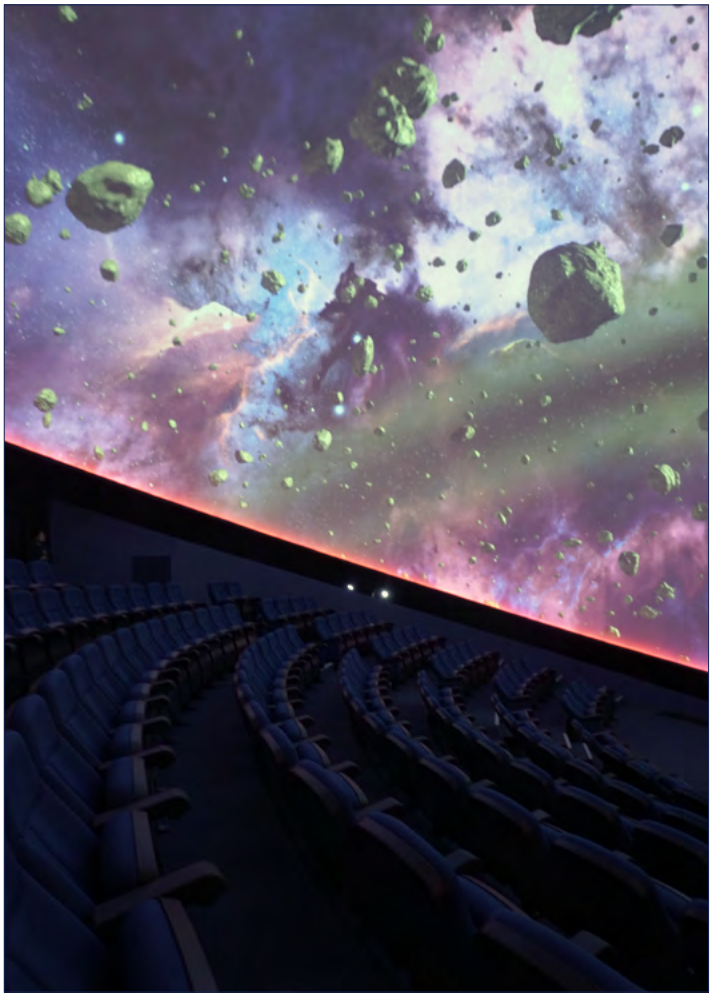


Figure 6: Strasbourg planetarium projection onto the dome © M. Holdrinet - Jardin des sciences.

approach and are not converted into pure entertainment or used as a simple communication argument. How can one not be impressed by the images projected onto the dome? With some 64 million pixels, each measuring 2.56 mm on a side, visitors are experiencing a striking feeling of depth without using 3D glasses!

Cosmoscité's cultural program has been designed to share the current state of sciences and the way they are developed. It also aims to highlight how sciences have to cope with challenges nowadays, such as climate change. All of this while trying to let visitors experience a scientific adventure.

Hence, the exhibitions integrate devices mixing games, more serious manipulations, and role-playing, and try to shed light on the big questions: Where do we come from, are we unique, how is our universe and our earth evolving, and is it possible to predict everything?

The science communicators will also accompany visitors to the planetarium and the immersive room, where the emphasis has been placed on wonder and sensitive perception, as well as on the involvement of visitors. For example, the virtual escape room, *Ice Core Adventure,* takes participants on a journey from glacier fields to laboratories to reconstruct the human origin of global warming step by step.

We have dreams for the future and a role to play

At Vulcania, as elsewhere, the opening of the planetarium has required a major effort from the park's teams to create new activities. But much remains to be done. Among the projects we are considering are activities under the dome for children, observation evenings, organisation of events such as the *Nuit des étoiles* (a France wide event dedicated to observing night sky), and astronomy-related shows under the planetarium dome. We have so many dreams to be realised in the years to come.

As for Cosmocité, the teams are dreaming of concerts under the starry sky, events linked to science news, new scientific escape rooms, and immersive and sensory experiences for the very young public. They imagine the development of a planetarium-like community for immersive and interactive rooms. They imagine a teeming neighbourhood life in the vicinity, but also within Cosmocité, which would have become a meeting place for friends as much as a place to visit... A lot of dreams and desires that will perhaps be fulfilled for the planetarium bicentenary. But it is necessary to build patiently and humbly in a planetarium community that we have just joined.

In Douai, the future seems to be even closer as we are already looking ahead a dozen years. We may already have to renew our projection equipment. At the speed things are going, it could be that the technology of large active screens for planetariums has reached maturity. If it were offered at "affordable" prices, there might be nothing more we could expect, unless technological advances exceed our expectations.

Between now and then, space news will once again provide great emotions to share with our audiences, such as the return of humans to the Moon and a second wave of landings on its regolith. These are events to be experienced in our dome, to write together these new pages of space exploration history that may be broadcasted in fulldome.

We feel our planetarium as a unique place, a showcase for astronomy that allows the public to put things into perspective. We feel it as a way to disconnect and to contextualise the place of Earth in the Universe. Attending a planetarium show is as much an emotional experience as it is thought-provoking. In Strasbourg, we want to strengthen our role as a link between society and research by offering original evenings linking arts and sciences, stimulating round tables on environmental issues, and observation activities, which place us, along with the public, under the "real" sky. For there is nothing more beautiful than looking into the sky with our feet firmly planted on the ground.

All these dreams echo the obvious societal role of planetariums. Like astronomy, which they help to make accessible to as many people as possible, planetariums are a window on the world. They act to facilitate awareness of the balance of nature, the fragility of our planet, and to illustrate the evolution of our universe .... They give us human beings an irreplaceable cosmic perspective.

RICORDI DEL MIO SOGNO MEMORIES OF MY DREAM

REPORT ON AN EXPERIENCE IN ITALY 2023

By Andy Kreyche

Not Everything Turns Out as Planned (literally "not all donuts come out with holes")

The *Experience In Italy* program picks an educator each year from a US planetarium to travel to Italy. Since 1995, for ten days each spring, the person chosen travels to select places to teach astronomy lessons in English to Italian students. After I read accounts published here, written by past winners, teaching in Italy became something I started to dream about doing. But unlike dreams that spring from the unconscious, this one requires a formal application to materialize. In 2019, I finally submitted mine, and later that year, on September 30th, while standing in front of the post office in Kettle Falls, Washington, I received confirmation that this dream would come true.

My wife, April, and I were winding down the last two days of vacation before flying home to California the next day. I assumed Kettle Falls would be a place with reliable cell reception, based on the relative size of its dot on the map. I had a window of time with instructions to call Susan Button, IPS Portable Planetarium Committee Chair and liaison to the *Experience In Italy* program. As it turned out, I had to walk a few blocks off of the main highway to find a decent signal. While locals went in and out of the building attending to their daily business, I received the news of a lifetime. I was selected to teach in Italy the following spring! Before getting back on the road, April and I had a celebratory lunch, washed down with a bottle of San Pellegrino sparkling water in anticipation of the experience to come in seven months.

Throughout the fall, my excitement bubbled over as I contacted my Italian hosts and built a month-long European itinerary around the dates for the program. With plans now firmly in place, New Year's Day 2020 brought with it a real reason for optimism. Our first trip off of the North American continent would begin on March 16, 2020—or so we thought.

The post office in Kettle Falls Washington, as seen on September 30, 2019.

Finché c'è vita c'è speranza

While There Is Life, There Is Hope

By the time our planned departure date arrived, my dream of going to Italy was dashed, far superseded by the planetwide nightmare of Covid. Italy was an especially grim hotspot. The portable planetarium business I'd started a few years earlier came to a standstill, and ultimately wouldn't survive the pandemic. But I reminded myself there was much to be thankful for. April provided support, emotional and otherwise. Her job working for a company providing streaming content was more secure than ever, with so many people now staying home. And the promise of us going to Italy together served as a helpful, hopeful goal.

With so much of life moving online, I enrolled in online Italian language and cooking classes. I also attended monthly "Not Only Stars" presentations. Led by Kevin Milani, the 2018 *Experience In Italy* winner, these virtual gatherings continue even now as an extension of the program, maintaining connections with the Italian hosts and students. The sessions focus largely on Italian/American connections in history, culture, and language, with a bit of astronomy thrown in. I also stayed in touch via WhatsApp with Loris Ramponi, who coordinates the program. For a time, Loris couldn't venture further than 200 meters from his home in Northern Italy, so we shared voice messages, and I sent pictures from our local beach. We also shared photos of mutual interests: food and astronomical phenomena.

Trovarsi tra l'incudine e il martello

Between a Rock and a Hard Place (literally, "an anvil and a hammer")

Because of strict restrictions in schools, the *Experience In Italy* initiative remained on hold in 2021, and again in 2022. But throughout the pandemic, Loris reassured me of the program's commitment to my visit. Then, late in 2022, he informed me that the program would resume the upcoming spring. Dates were selected and new hosts recruited, with just the final details to be confirmed.

By this time, I'd accepted a job running a community college planetarium where I'd worked previously. My dean submitted my request for time off: comp time to cover the period when I would be teaching and all my vacation leave to explore Europe after the program ended. She was supportive, but also wary of gaining the approvals that would be required.

At first, the request was denied without explanation. When I asked for clarification, I was told that representing the institution while teaching in Italy provided "no benefit to the college." Despite follow-up meetings and negotiations, a line was clearly drawn in the sand: I must use my vacation time to participate in the program, and being gone any longer would result in my termination. I made peace with resigning my position and offered to return to work temporarily after Italy to fulfill existing obligations to school groups. I was told that a substitute could easily be found to take my place. So, I gave my two weeks' notice. In this way, and all in a matter of weeks, the job I'd thought would be my last before retirement ended.

Coraggio, sei quasi arrivato!

Come On, You're Almost There!

Given all the turmoil during the weeks approaching departure, I welcomed the practical preparations during the last days before leaving. The program calls for teaching one main activity, usually during a single class period, and most often to high school students as part of their English language classes. A detailed description of the lesson was a key part of the application, along with listing any specialized English vocabulary the students should learn in advance.

Panoramic view of Perugia and the Umbra Valley.

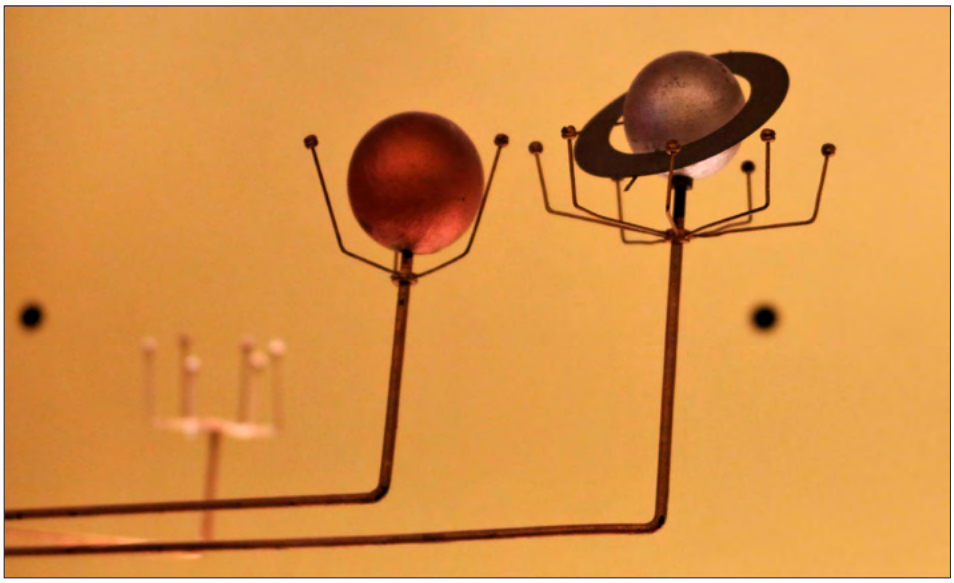
The activity I chose to do was "The Human Orrery," which I had demonstrated at the Live Interactive Planetarium Symposium (LIPS) conference in 2018 in Seattle, WA. Although it's not the simplest lesson to set up or facilitate, I think the payoff is worth the extra effort. In my experience, it is best suited to high school level students. I start by having students place a set of four looped ropes into concentric circles to mark the scaled orbits of the inner planets of the solar system. Then, as the remaining students watch, five students take positions in the model, representing the Sun, Mercury, Venus, Mars, and, of course, Earth. The activity requires a clear, large space, since the orbit of Mars is scaled to an 8.6-meter diameter. With the model in place, I review the daily motion of the Earth and our view from it, along with the ongoing orbital movements of these planets over the course of an Earth year. We've all seen diagrams showing a view of the solar system from above. This lesson connects that broader view with our earthbound perspective. Starting off with an open-ended question, "Which planet is closest to Earth?", the activity demonstrates what planets we see in the sky, bringing together the when, where, and why of it all.

I packed away my large spool of nautical ropes in an extra suitcase, along with materials for the activity to be presented at teacher workshops in Italy. As educators, we know we can never be too prepared. So, upon finding a surprising amount of additional room remaining, I proceeded to fill all the remaining space. I included gifts, additional activities, and an entire box of various NASA stickers. I had planned to bring the stickers so every one of the Italian students I encountered could select one as a keepsake. Souvenirs help trigger memories. I would surely bring mementos back from Italy with me. In the same way, I wanted to keep the experience alive for the students. At the completion of the program, I planned to leave the ropes and any leftover materials with my final host, hoping they could utilize them.

Nel cuore verde d'Italia: Perugia e Assisi

Into the Green Heart of Italy: Perugia and Assisi

Finally, a Sunday afternoon departure from the San Francisco airport on March 19th, 2023, set this long-awaited trip into motion. A layover in Germany was followed by a quick flight over the Alps and into Italy. On approach to Florence, for a landing at sunset on Monday, I gazed down to see the Tuscan hills during the magnificent golden hour. The landscape was similar to that of the Central Coast of California we'd left behind, but I keyed into distinctions,



Detail from a 19th Century planetarium, or solar system model, on display at the Museo Galileo, Florence.

like the many villas and vineyards in the countryside. The warm, glowing light served to heighten my anticipation for so many more delightful differences yet to come. Following this idyllic (or perhaps idealized) arrival, we rode into town with a lifelong Florentine cabbie and then checked into our Airbnb. The fantasy continued to be fulfilled that night as we chanced upon one of the tastiest meals of the entire trip at an unassuming neighborhood osteria a short walk away.

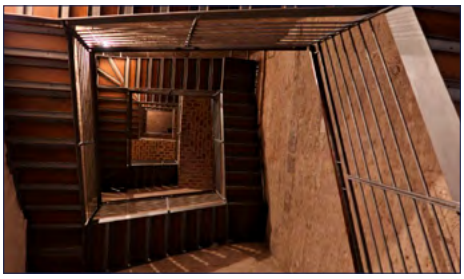
April and I spent those first days in Florence exploring and becoming acclimated to an ancient city, and ancient everything. Photographs could not prepare us for being surrounded by so much history. Our activities included touring the Museo Galileo (planned) and a virtual visit to an Italian doctor (unplanned, but cheap, easy, and successful). After three full days, Tuesday through Thursday in Tuscany, it was on to Umbria. On Friday, we boarded a train to Perugia, home base for the first part of the program, arriving there three days before it was to start. Longtime program host, Simonetta Ercoli, met us at the train station and drove us to our Airbnb, meticulously decorated by its antique dealer and owner. Although part of a 1930s-era apartment building, it felt like our own private villa. We spent the weekend getting to know this new city, from enjoying its famous chocolate and taking in panoramic views of the Tiber and Umbra valleys to shopping at the local grocery stores and markets.

We wandered through the narrow streets of this university town, at times losing our way. On Sunday I sat in on activities Simonetta led with her former protégé, Luca, on behalf of their outreach organization, StarLight, un planetario tra le dita (StarLight, a handy planetarium). In the afternoon, class children and parents observed with a solar telescope and assembled ingenious, locally designed paper sundials. The class took place alongside a 13th-century church at a grassy piazza, which was full of people casually socializing, as is always the case in such public spaces throughout Italy. An evening session for the public followed. This took place both inside and atop the medieval Sciri Tower, for which Simonetta has a key (how cool is that!). Once inside, we hauled telescope parts awkwardly up narrow stairways. There are 232 steps to reach the top. Fortunately, a winch hooked to a small platform took the equipment from an intermediate landing the rest of the way up.

Once at the top, I felt the cool breeze and was overwhelmed by the dramatic panorama of Perugia and the surrounding area. The familiar view of the Moon and Venus greeted me. Travel is exciting, but also disorienting. These old celestial friends, slowly sinking together toward the western horizon, was a most welcome sight. Although I was 42 meters up, I felt grounded. I knew exactly where I was. I was connected—to the Earth, the northern hemisphere, and just a little bit more to Italy. Perched on high, I soaked in the sights and sounds as evening deepened: historic buildings garishly lit up amid the otherwise darkened city, occasional car horns, sirens, and groups of voices passing below, the stars of Orion playing peek-a-boo with passing clouds, and confident astronomical explanations in rapid-fire Italian.

Early the next day, Simonetta picked me up for the 30-minute drive to Assisi. Round trips would be repeated for three of the next four days as I met with many high school classes and led a teacher workshop at il Convitto Nationale di Assisi (The National Boarding School of Assisi). Before that first lesson, I only felt a bit nervous. I was looking forward to breaking the ice and then getting the most out of the experience of the program. I wanted to do well. Walking up the front steps, the school seemed familiar. The plaster walls and red tile roof were reminiscent of my Catholic elementary school in Tucson, AZ, along with many schools in California with Spanish Mission style architecture. But again, being attentive to differences, I noticed the school had a welcoming feel. By contrast, US schools these days, much like the walled Italian cities I'd encountered, seem to be designed as impenetrable fortresses. Another difference? This school has a coffee bar!

I returned from Assisi encouraged by a successful first day. The activity fit within the assigned multipurpose room, barely though, as the orbit of Mars was a bit squeezed. The students' English fluency was impressive, so I was able to complete the lessons in the time allotted and, best of all, we all enjoyed ourselves. While preparing for dinner, I checked in on the goings-on back home, only to read the grim news of a school shooting that had taken place that same day in the Green Hills area of Nashville, Tennessee. Six lives tragically and violently shortened in an all-too-familiar, American way.



Clockwise from above: Participants in a class led by Simonetta Ercoli, the tallest woman in Italy ;-); Looking up inside the Sciri Tower in Perugia. Or is it down?; High school students in Assisi decide on which souvenir sticker to choose after the conclusion of a Human Orrery lesson.

Green hills are abundant in Umbria, giving it the nickname, the green heart of the country. Simonetta proved to be a wonderful companion and guide to this region. It was a pleasure to spend time with someone so like-minded about sharing science through hands-on learning. We traded materials, and she gave me a beautiful book about the constellations that she wrote. Raised in Perugia, Simonetta is firmly connected to the area and eager to share her knowledge about its rich culture and history.

The program asked that I give a brief introduction to each student group prior to leading each lesson. I was to tell a bit about myself and the place I live, Santa Cruz, California. Over the last few years, I've been involved in learning about and supporting Indigenous people and practices. So, I highlighted some of that knowledge. America may have been named after an Italian, but I reminded the students that an incredibly wide variety of native cultures thrived on the continent for millennia prior to 1492, and they still do today. The students seemed both intrigued and surprised to hear this perspective.

Repeatedly in Italy, I came face to face with artifacts dating back not just hundreds of years, but thousands. While in Perugia I made a point of walking through the Etruscan Arch, built in the third century BC. Cars whizzed through it, seemingly taking it for granted, while I, though familiar with astronomical time scales, could barely fathom the experience. How many people have passed through this arch in the over 5,000 years it has stood here? How many more will do so in the future? I'm in awe of the ability to create such lasting physical legacies within a human time frame. But I'm also trying to learn from the ways of the Amah Mutsun, the native people of the region where I live. Their values are evident in the wisdom they have gained by cultivating the natural connection to their home. Simonetta and my other Italian hosts seem to embody this spirit. Where they live seems to play a large part in who they are. I experienced this with a pride of place that was generously shared. But there seems to be a sense of place that goes even deeper.

Pace e bene: Amelia

Peace and Goodness: Amelia

Our time in Perugia included other unsettling news from home when April found out she'd been laid off from her job. After the initial shock wore off, we had more reason to simply live in the moment and appreciate the rich experience of each day and the people we encountered. Our week in Perugia concluded late on Thursday as Simonetta drove us through the lush Umbrian countryside to the southernmost part of the region. Once there, she would hand us off to our next host. Unlike in Perugia and Assisi, where the program took place only in schools, we would be staying in a facility with a planetarium. But this dome would be unlike any that I could ever imagine existing in the US. Our destination was the Convento Francescano della Santisssima Annunziata (Franciscan Convent* of the Most Holy Annunciation), located in an idyllic rural area 5 km outside the town of Amelia. Here, at a location new to the program and with a first-time host, we would be breaking new ground.

A few days earlier, after a light day of teaching in Assisi, Simonetta led April and me through the place forever associated with St. Francis. We visited his crypt and strolled through the beautiful and well-kept town, noticing the saying "Pace e Bene" on many souvenirs in the ubiquitous tourist shops. Well, peace and goodness were plentiful beyond measure during our stay in Amelia, and the spirit of St. Francis was embodied by our host, Fra Andrea Frigo. Andrea is the youngest of five Franciscan friars living at the convent, and his responsibilities and activities seem as endless as his talent, humility, enthusiasm, and kindness.

The planetarium features an Italian-made Gambato opto-mechanical projector and a 6-meter dome built into a former hay barn. Fra Andrea returned the 1980s-era planetarium to full operation after years of dormancy. He now hosts regular school groups and public programs, as well as a yearly festival. In addition, Andrea created a remarkable science museum on the bottom floor of the convent opposite the planetarium. Open since the fall of 2022, "Museo della scienzia" houses a unique array of scientific paraphernalia used in education during past centuries at other Franciscan outposts. From vacuum chambers with heavy glass lids to yellowed bottles of chemicals, cataloged botanical samples to Faraday coils, wax sealed bottles of snakes in formaldehyde to old alcohol meters, browsing this collection fired my imagination. There have been

and continue to be many instances where science and religion clash. But pondering the source of these items reminded me of a history where advancing scientific knowledge was embraced as a valuable part of religious education. The new home for these artifacts, and their curator, combined to instill hope for a more inclusive and complimentary future where theology and science can coexist as they do so beautifully here.

While at the convent, we stayed in a sparse but comfortable room apart from the friars' quarters. WiFi was available throughout the buildings, but I spent little time online. The serenity of the surroundings provided a calming retreat and sufficient "connection." Our meals with the friars in the dining hall were a communal, grounding, and an incredibly tasty activity. Multiple courses of food appeared (dare I say "miraculously"?!), featuring produce from both the kitchen garden and the field where crops of lentils and garbanzo beans are grown. Complementing the meals were an array of beverages, including wine made by Andrea's father in Verona. To more fully appreciate the friars' lifestyle, I set an early alarm one morning to have the chance to sit with them during their morning prayers, which echoed within the walls just as they have for centuries.

My educational duties consisted of working with a group of visiting middle school classes, holding a workshop with teachers, and presenting an evening public program in the planetarium. These events did not have the strict time limitations of the school visits in Assisi. They flowed easily, in tune with the spirit of this place of reverence and reflection. I was able to lead additional activities, and Andrea showed astonishing photos of the aurora he'd taken during a recent expedition to Iceland. Trading off was a relaxing way to both teach and learn, and he and I became an easy-going tag team.

On the day the middle schoolers arrived, they were all gathered into a big circle with us and their teachers. Andrea asked each person present to share their name and age and answer the question: "What is your dream?" The responses provided fascinating insights into the minds of these young adolescents. When it came time to give my answer, I told the assembled group that my dream was to come to Italy to teach astronomy. I said quite honestly: "I am living my dream."

** In my experience, the word "convent" in English always referred to communities of nuns and other religious women. In contrast, I associated monasteries with communities of men or priests. In Italy, the terms monastero and convento aren't tied to gender. Religious people in a monastery live apart from the everyday world, and their prayer is centered strictly within their monastic community. Members of a convent, on the other hand, often have jobs in the outside community during the day, returning to live in their convent, a place where meals, prayer, and other aspects of common life are shared. The word "convent" comes from a Latin word that means "to convene or gather."*

Un altro sogno diventa realtà: Ravenna

Another Dream Comes True: Ravenna

A pre-dawn Sunday train took us to another new place, il Planetario di Ravenna (The Planetarium of Ravenna), another first-time participant in the program. While in Ravenna we certainly received far more from our hosts than I gave back in terms of educational time or value. Our Sunday arrival meant a day free from any teaching obligations. Prior to a delightful dinner that evening, our hosts treated us to a private tour, led by a professional guide, of a city I had wanted to visit for more than 40 years.

A favorite professor of mine in college kindled in me an appreciation for the culture, art, and architecture of the ancient world. In his intro to humanities class, we studied sites in Ravenna, a place he was passionate about. To this day, I remember him insisting that if we were to ever visit Italy, Ravenna, not Venice or Rome, was the go-to place. Late that first afternoon, during the tour, we marveled under a dome of magnificent stars. But we weren't in a planetarium. Ravenna is often called the city of mosaics, and these stars were made up of countless golden glass tesserae set against a luxuriously deep blue sky in the Mausoleum of Galla Placidia. Said to have inspired the Cole Porter song, "Night and Day," this vision of the heavens was one of a multitude of designs, featuring a stunning array of colors. These appear in a fifth century building whose modest size and appearance from the outside betray no hint whatsoever of the splendors awaiting those who enter. Scenes inspired by Bible passages share wall and ceiling space with intricate kaleidoscopic patterns, depictions of nature, and borders with 3D effects. The effect was simultaneously stimulating and incredibly calming.

The next day it was back to "work," but it hardly seemed like it. I walked the few blocks from our upscale hotel to the planetarium. Like the facility at the convent, this planetarium came to being in the 1980s and was built in a spacious public park. With a background of joyful sounds from a nearby children's playground, the exceptionally dedicated Marco Garoni gave me a tour of the facility he runs. Meanwhile, April was off creating a mosaic keepsake (at no charge) at a studio run by Marco's sister; yet another act of generosity provided by our host.

The planetarium building includes classroom and office spaces and an 8-meter dome. A beautifully decorated exterior wall features a vertical sundial, in addition to an analemma and various astronomical charts. Fitting with the reputation of its home city, mosaics of zodiac constellation symbols are embedded in the floor all around the perimeter of the planetarium. The projector is a Zeiss ZKP2 that Marco lovingly and skillfully maintains. The displays and educational materials, along with the opto-mechanical projector, support the teaching of foundational astronomical concepts, so my orrery and a shadow activity I brought fit right in. A group of middle school students and their teachers arrived, so we convened in the classroom for my introduction. But being such a pleasant day, all the rest of our interaction took place outdoors. As with American middle school students,

Middle school student group visiting the Planetario di Amelia.

attention spans reached their limit by the time the main activity concluded.

Just as we were wrapping up, a young woman approached me. In perfect English, she asked, "What are you doing here?" I told her about the program and briefly explained the orrery activity. My reply confirmed her suspicions. As a grad student recently arrived from South Carolina, she had been watching the activity from a distance while lounging in the park with friends. She somehow determined the style of the activity to be American. Guilty as charged.

Dieci ore frenetiche: Brescia e Lumezzane

Ten Jam-Packed Hours: Brescia and Lumezzane

As the program progressed, each stay became shorter. After three nights in Amelia and two in Ravenna, we arrived in Brescia on Tuesday afternoon with plans to stay overnight and leave first thing on Wednesday. If there was one disappointment about the trip, it was the little amount of time I was able to spend with Loris Ramponi, organizer of the initiative. Brescia and the Serafino Zani Observatory in nearby Lumezzane serve as his home base, and he is also involved in many other activities with Associazione dei Planetari Italiani (The Italian Association of Planetaria, or "PlanIt").

After our 2 PM arrival in Brescia, my one lesson was to take place at 4:30 inside the municipal theater in Lumezzane, a town 30 minutes away in the foothills of the Alps. The event was open to the public, but the primary audience at the theater would be three classes of high school students, all taught by Allessandra Seneci, whom I'd met online at the "Not Only Stars" presentations. Loris had shared the newspaper article with me promoting my appearance, and based on a conversation with a past winner, I was prepared for this to be a big deal. And it was. You'd have thought it was Neil deGrasse Tyson, not me, who was coming to town.

The dizzying chain of events from our arrival in Brescia to setting up at the theater in Lumezzane included confusion at the train station, a brief meeting with Loris at Brescia Castle, a minor traffic accident on the way to our hotel, and my realization that there wouldn't be enough room for the activity at the small space set aside in the theater. Fortunately, once I arrived, I was able to make arrangements to take over the main stage of the facility after my introduction. The students were excited, the anticipation palpable, and once things got underway, I was energized.

After the previous 8 days of the program, I was well-practiced at leading the lesson, and it went well. Afterwards, there was an extended period of Q&A, followed by a speech by a representative of the city and group photos. While the event was winding down and students selected their souvenir stickers, several approached me to ask if they could take selfies with me and ask follow-up questions. I happily obliged, thoroughly enjoying their enthusiasm. Looking back, I'm glad I seemed to live up to the hype but if Neil de Grasse Tyson consistently lives his life at such a frantic pace, I wouldn't want to switch places.

After quickly packing up, there was no time to waste before getting moving again! Groups of us in several cars left the theater to go to the nearby high school. There, we were led on a quick walkthrough of their planetarium (6-meter dome, Gambato opto-mechanical projector). With no time to waste, we piled back into our vehicles so we could make it to the Serafino Zani Observatory by sunset. After a drive with countless twists and turns up the side of a mountain, we admired the view and met up with some of the collaborators who were instrumental in the observatory being built in 1993. Inside, a Ritchey Chretien 400mm telescope (f/8) occupies a beautifully constructed dome with an adjoining classroom. With the moon up and night falling, we walked to a nearby chapel, open only because it was Easter week. The view of Lumezzane from above was stunning, with the last light of dusk fading into night. I paused and didn't want to leave, but it was time to move again. So down the mountain we went, back to town and a pizza dinner.

Later, while heading back to the hotel in Brescia with a full belly, there was time to reflect on how the previous few hours had gone by in such a quick, but gratifying blur. Once we arrived and I got out of the car, I realized that,

(Continued on pg. 62)

FULLDOME FESTIVAL BRNO
A RECAP

Greetings from the nineth Fulldome Festival in Brno, Czech Republic, held in 2023.

As always, the festival was a wonderful opportunity to meet colleagues face to face again to discuss their profession and to look at numerous Fulldome shows from all over the world.

This year, a special guest from Ukraine made his way to Brno. Igor Berezyukov, biologist, poet, and painter joined us as representative of the Kharkov Planetarium in the Ukraine.

He biked his way from Kharkov to Brno, over 1.600 kilometres, a journey that took him 14 days. He visited some planetariums in between and even injured himself in a fall from his bicycle. Igor never gave up though because he was on a mission; a mission to remind all of us that there is still a war going on the European continent and that many of our colleagues and institutions are under threat.

Before he started his bike ride to Brno, Igor packed a few kilos of shrapnel with him to hand out to participants of the festival; plenty of evidence from a place sieged by Russian military.

We all got a tangible piece of this reality in which our fellow planetarian must live - a strong and very sad reminder.

However, it is not hate but instead peace and love that we all should push for, and convey to the younger generation in our planetariums. That is what Igor is passionate about and he touched all of us with his hopeful spirit for a better future.

A stop at the Okhtyrka Planetarium near Oblast.

Kharkov is Ukraine's second-biggest city, located in the east of Ukraine just 30 miles from the Russian border, with a population of around 1.4 million people. "It was missile attacks and bombing from day one on February 24, 2022," Igor said. "There would be air alarms every three hours. People living underground, which is absolutely crazy to see in the 21st century. At night, the drones do their evil work."

A month later, Putin's forces fired missiles at many civilian targets, among them the Kharkov Institute of Physics and Technology. The Planetarium and its rooftop observatory in war-torn Kharkov are still intact. The planetarium opened in 1957 under Soviet regime, parallel to the launch of the world's first artificial satellite. The planetarium hosts several memorabilia from this era.

Over the years, the Brno Fulldome Film festival took it upon itself to screen Fulldome movies produced within the Ukraine. This year, the Noosphere Planetarium from Dnipro presented a movie at the festival. It is a modernized planetarium even closer to the war front then Kharkov.

One day, this war will be in our memories. Until that moment, we need to give support to our partners and reach out. Please do.

You can reach Igor at *berezyuk44igor@gmail.com*

https://planetarium-kharkov.org/?q=kharkov-planetarium-eng

https://www.facebook.com/planetarium.kharkov

On the day of this writing, during the night, Russia continued airstrikes on Ukraine's second largest city. Among other things, a sports complex of a university and other civilian buildings are said to have been hit.

Prof. Thomas Kraupe

Johan Gysenbergs

PLANETARIUM UPDATES

Bratislava, Slovakia, July 10, 2023

Dear Friends of Planetaria and Colleagues in IPS!

Bratislava remains one of the last capitals in Europe without a planetarium or even a public observatory. Throughout the 20th century, several projects were proposed, but unfortunately, they all failed for various reasons. For example, a planetarium setup was purchased from Carl Zeiss and shipped to Bratislava in 1958, but the construction never commenced. After 20 years, the unopened boxes were sent to Prague to be used as spare parts for their machines, which had been bought at the same time.

Renderings © Woal and GFI Architects

Our association has been working on a project to establish a modern planetarium for Bratislava since 2013. In 2015, we successfully incorporated this investment into the agreement between Bratislava City and a private developer constructing a new urban precinct on the Danube River embankment (see *https://www.ips-planetarium.org/news/news.asp?id=384124*).

In 2018, we signed a collaboration agreement between the city, an investor, and our association to cooperate and further develop the project. As the process moved forward, we collaborated closely with architects, interior designers, technology providers, and other professionals. We prepared a comprehensive operational plan, economic forecasts, program dramaturgy, and even proposed names for the new institution, believing it could become one of Bratislava's most visited venues.

Unfortunately, despite our substantial progress, the project was not completed. After the recent elections, the city mayor and his team changed their stance and expressed their intention to cancel this investment in December 2022 in exchange for cash for the city budget. Following a period of uncertainty, this decision materialised into a sudden proposal to cancel the planetarium project, a mere six days before the city council's vote.

Despite our extensive efforts to communicate the project's significance to the city and its residents, the officials voted on June 29, 2023, to abandon the planetarium project. We had emphasised that the original agreement compelled the private investor to build and operate the planetarium for the next 30 years. Yet, the new proposal replaced all that for nothing more than creating documentation for two unrelated urbanisation projects and future cash injection of 8.18 million Euros.

Regrettably, our advocacy was insufficient to overturn the proposed new deal, and the city council voted to terminate the ongoing project of the new planetarium. The only minor concession made was a commitment to study the potential for a new location for a future planetarium project in Bratislava, albeit without any assurance of funding or earnest consideration. This outcome makes us fear that yet another generation of children in Bratislava may grow up without the opportunity to visit a planetarium.

Despite the setback, we remain committed to the vision of a planetarium for Bratislava. We have initiated meetings with institutions that might potentially support such an endeavour. Nevertheless, we are essentially starting from scratch.

On behalf of Slovak Planetariums,

Juraj Kubica, PhD.

Julieta Aguilera
julietina@me.com

IMMERSIVE MATTERS
ENGAGEMENT IN FULLDOME

During one of our IMERSA Day's mingling a few months ago, there was a casual discussion regarding the kind of shows and experiences that are afforded today in fulldome. For some reason, the word "education" was used as the opposite to "entertainment" and that seemed like a strange dichotomy to me. It struck me that I have never met an educator wanting to make boring things, or an entertainer wanting to convey nothing beyond a feeling. My immediate response was to ask as to whether a common denominator is perhaps engagement. That is, considering engagement as the state that opens our senses and thoughts – and everything in between– to new experiences, while at the same time making memories that are worth recalling and savoring afterwards to in turn build new ideas in our minds. The more I thought about this, the more I wondered if there is really a division somewhere, and whether perhaps the dichotomy is just a marketing ploy that undermines either aspect, depending on the target function. It's a move sometimes used much to the detriment of the work that navigates between disciplines devoted in various proportions to senses and thoughts, and the necessary cross disciplinary work that can make shows remarkable.

Today, immersive media challenges us to question the usefulness of old dichotomies for the development of new concepts. This becomes critical as experts from a wider scope of disciplines are needed and called upon to collaborate on a well-rounded project. The aesthetic, scholarly, and/or scientific complexity that the public may expect today is also pushing experiences to new levels that no one single discipline can achieve in a single outcome. This is where the dichotomy of education/entertainment has perhaps become a roadblock of sorts.

Let's consider what different disciplines want when using media at some level, namely engagement. Then let's look at some of the kinds of mediated experiences that have resulted in the development of concepts; we may reflect on how these concepts may support or constrain the creation of immersive experiences in fulldome. Finally, let's venture on imagining ways to advance fulldome shows and experiences that articulate sensory and intellectual premises among the disciplines involved in their creative process.

Engagement

The sensory appeal to support immersion is a particularly strong fulldome quality. Various kinds of experiences take advantage of this in order to engage the public. Many fulldome materials -- both live and recorded -- are produced, not with the aim to bore people or to merely produce a transient feeling. The fulldome immersive environment has a strong perceptual impact, which affords perhaps more complex means of guided perception than other media. In such an immersive context, engagement can be broadly considered a movement from disengaged to engaged and then hand-held. It then maintains a connection, sometimes led via a story narrative, and sometimes led through visual interest in a journey that meanders through various degrees of focus and un-focus. In that regard, an engaged state can connect the new with the familiar and the known with the unknown. We can think of said unfocused and focused states as beats and the silence in between. Can there be sound without silence, and vice-versa? It is common knowledge that perception roughly works like this: once we become accustomed to something, the something disappears from our attention. So, it would be reasonable to say that engagement is not a continuous focus or a continuous lack of focus, but the back and forth flow between those states, like silence and sound are for hearing, or like light and darkness are for vision. Through this choreography of attention, memory works because there are emotions attached to it, as Antonio Damasio states:

"The perception of any of (these) items generates emotions and feelings, and, in turn, the feelings accomplish the separation between the contents that belong to the self and those that do not. From my perspective, such feelings operate as markers. They are the emotion-based signals I designate as somatic markers" (Self Comes to Mind, 2010, Chapter 1).

Old Dichotomies

Perceiving and thinking happens alongside switching focus, losing focus, and refocusing. Focus may start in the act of sensory perception (aesthetic) but then this perception may weave in reflection. Thus, thoughts build up from what is perceived, sometimes going further into the elaboration of concepts.

Understanding this basic continuum of perception/aesthetics and thoughts/concepts means that one can see that there is no division between them, but rather that it is one process. An aspect can be dominant, but that does not mean other aspects have disappeared. The reason I emphasize this is because a fulldome environment is intrinsically aesthetically powerful. Think of the many experiences that we've had as Planetarians, from story-driven shows to performances, as well as various hybrids of them.

In this regard, drawing a line between education and entertainment, one may unconsciously stifle aspects of this continuum and end up with a stereotype. I would argue that is an

issue that we may want to reconsider in our community because the mental states that go from aesthetics to conceptualization are important. They are important in the building of a meaningful approach to experience development in fulldome as well as other creative and research endeavors. In summary, aiming to create works with a predominantly aesthetic or conceptual focus does not mean the works are exclusive to one or the other. Is a person supposed to be in the same mental state throughout a planetarium experience? Or through any kind of mediated experience? The aesthetic pleasure of focusing and defocusing is present in all immersive works. The rewarding achievement of conceptualizing is always present to some degree.

Let's take a look at where the terms "education" and "entertainment" come from in western languages to see if we can reconsider them in the context of immersive experiences.

Education comes from the Latin "educat" which means 'led out.' That is –if I may interpret it in terms of physical and mental space–, a movement into the open.

Entertainment also comes from Latin "inter" for 'among' and "tenir" for 'hold" which was commonly used as hospitality in the past: to maintain, which we could roughly understand in today's media context as attention.

Revisiting these terms of the creative processes in immersive media may help us better connect work among various disciplines because work designed for fulldome both maintain (entertain) and move (know) in very fluid physical and conceptual ways simultaneously. In a way, different disciplines themselves exist in a continuum around the human experience.

Words and experiences

When considering where language comes from, it is readily apparent that it originates from experiences. As Lakoff and Johnson explain:

"... for example, HAPPY IS UP. The fact that the concept HAPPY is oriented UP leads to English expressions like "I'm feeling up today." Such metaphorical orientations are not arbitrary. They have a basis in our physical and cultural experience" (Metaphors We Live By, 1980, Chapter 4).

It is only natural then to reflect on how the experiences we create in fulldome open up the capacity to build concepts for those experiencing those immersive works.

If, on the other hand, we consider stories that are told in fulldome, we must keep in mind that the words in the stories themselves come with the baggage of captured experiences that resulted in the coining of each of the words. In turn, when words are assigned to describe something new, that ideally means that we understand our experiences. Learning a new concept therefore entails a word or set of words that capture the concept built through accumulated experiences. In doing so, conceptualizing requires experiencing, reaching the continuum that goes from perception through the processing of what is perceived, being engaged in a story, or even experiencing a sequence that moves and maintains attention.

But words need silence to form sentences and lead a story.

Years ago, I was designing a signage set for a public research site. The lead of the project saw the spaces between images and text and told me that we could add more information there -not understanding that the space was intentional to focus viewer attention. In visual design, the "empty" areas are called -- for lack of a better term -- "negative space" and it is this "negative space" that pushes the attention of the viewer along the content.

To explain it in another way: in musical terms, if everything is saturated with sound, there is only noise, and the music disappears. If we consider distraction and attention, either can also become noise when reaching a level of saturation. Whether a fulldome experience relies on an aesthetic topic or a particular story, the negative space of attention (or unfocused as opposed to focused attention) in all its sensory and conceptual forms, is necessary to engage in fulldome. Japanese anime films are very good at this: between scenes there may simply be a sequence of a rain drop falling in a water puddle, or tree leaves ruffling in the wind. In daily routines such as eating or dressing, the experience of life provides attentional negative space.

Further and deeper

The interplay of maintaining attention, switching focus, and leaving "negative space" between the parts of an immersive experience requires us to rethink how prompts to entertain (to maintain) and educate (to move) may overlap.

While in the past we may have considered just one or the other, perhaps even as competing priorities, today we are called to look at the whole of engagement in the immersive spaces that we build. This is because, in their very origin, our concepts do not exclude feelings or thoughts, aesthetics or concepts, as we explore fulldome works of various natures.

To this end, there is a necessary exchange among disciplines to achieve new levels of excellence. Whereas there is an old saying that goes as "divide and conquer," an update to the continuing work in the planetarium industry may as well say "unite and grow" where the added discipline expertise accounts for more than the sum of the parts.

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THE IMMERSIVE REVOLUTION

CXSYSTEM

CXDISPLAY

CX Display is the world's first and only Software Defined Display. It brings content to life like never before by wrapping guests in an immersive LED dome with best-in-class resolution, brightness, contrast, and lifespan.

CXENGINE

CX Engine is a suite of software applications for producing and presenting immersive experiences and Shared Reality Events. Equipped with unmatched content creation and image processing capabilities, CX Engine is the most versatile immersive experience engine in the market.

DIGISTAR 7

Digistar, the world's most advanced planetarium system, is built on top of CX Engine and places an entire universe of content at your fingertips. From free-flowing live, interactive, and scripted presentations to realtime astronomy simulations, Digistar's intuitive user interface and production environment will fit any organization's needs.

Unreal Integration

The Unreal Integration is an additional 3D production utility that fully integrates Unreal Engine for optimized playback and synchronization across any immersive display geometry. Built on CX Engine, this integration allows users to generate custom interactive content relevant to their audience and access a robust developer ecosystem.


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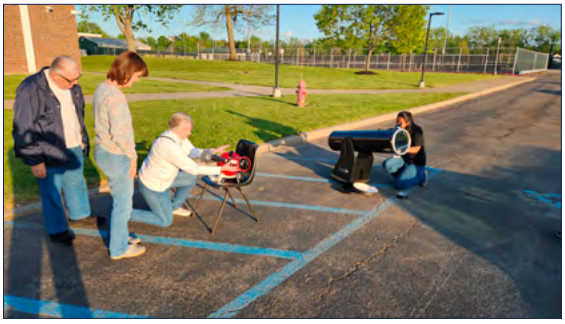
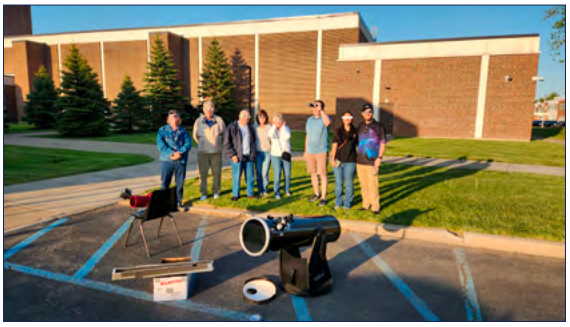
UNDER THE CLASSDOME

SEVEN MONTHS TO TOTALITY

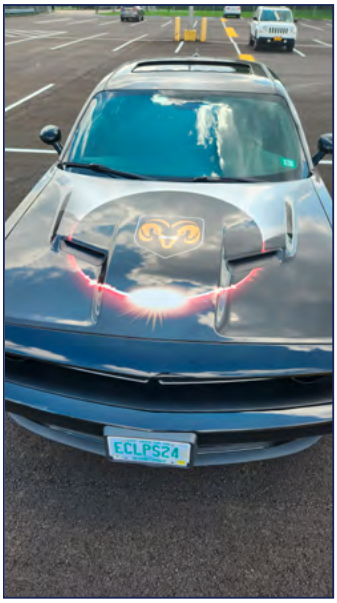
I knew it was going to be a crazy summer. As I write this, there are only 6 new moons to go until the moon's umbra visits Western New York. I had high hopes of providing a well vetted list of lessons and resources, but my work will have to continue into the fall because so much was going on to get ready for the eclipse.

I did manage to conduct more "solar eclipse deputy" classes. Each participant got hands-on time with each of the various solar viewing methods which is really critical for getting past the "fear factor." Besides the usual cloud dodging, I even had to run one session indoors because of smoky air from wildfires in Canada. One group at a time, I am building a corps of potential volunteers for our region. Once school is back in session, I'll be deputizing groups of teachers as well as leading lesson writing workshops.





An "eclipse evangelist"named Rik Yeames and his EclipseMobile made a visit. Michele Wistisen spoke at our monthly meeting to share her experiences leading the local preparations for the 2017 total eclipse in Casper, Wyoming. We held a press day with many local news stations attending.

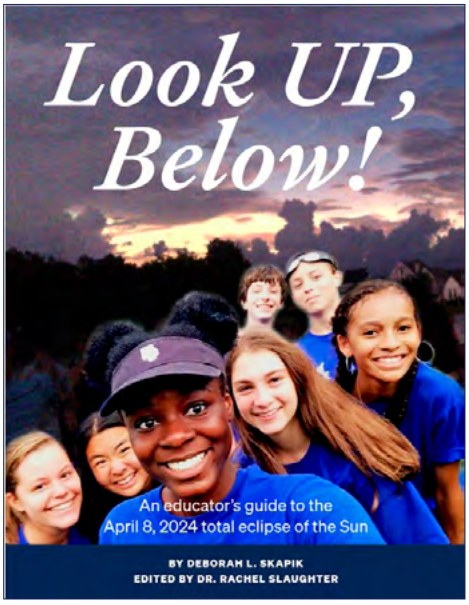


Most of our area schools have now decided to be closed on E-day, and many are making plans to purchase glasses for their students. Ken Miller - If you're out there reading this, thank you for the early and insistent advice to make all of these preparations!

With all that going on, I got very little time to dig into the countless ideas and vet them as I had hoped. However, a gift fell right in my lap! An educator and author named Deborah Skapik contacted me about her book Look UP, Below! My summer goal was to provide our teachers with specific and detailed lessons about the history, science and phenomena of eclipses. Deborah's book provides all of that with copyable activity pages! She even includes a playlist of eclipse related music! Here is an abbreviated table of contents:

1. Introduction
2. We're being followed by a moonshadow! - Eclipse Science
3. Are we there yet? How about now? - Eclipse Timing & Your Personal Timeline Worksheet
4. To look, or not to look? That is the question. - Safe Eclipse Viewing
5. It blinded me with science! - Eclipse Experiments
6. That's one small step for the Moon, one giant leap for humankind. - Eclipse Observation History
7. Dragons and demons and frogs, oh my! - Eclipse Folktales
8. Ready, Freddy? - Eclipse Preparation
9. Do you see what I see? - Eclipse Reflections

Deborah is also on a mission to reach underserved communities. In the USA, Title I is a federal education program that supports low income students throughout the nation. Teachers in Title 1 schools can obtain a free copy of Deborah's book (with a nominal shipping fee) of the book by emailing her at *dskapik@friendscentral.org*. The book is available to all at



https://dls-publications.myshopify.com/. I encourage you to take a look at this great resource. I discussed digital distribution with her because I think that the demand for her resource will go beyond the ability to distribute physical copies of this self-published resource.

The next item that I'd like to share with you comes by way of Lisa Swaney who directs the Horwitz-DeRemer Planetarium, Waukesha, WI, USA. We just couldn't fit this into the last column, but it's a great story about the partnership between her planetarium and the University of Wisconsin-Whitewater.

Death from Below, Death from Above

Prof. Bob Benjamin - Chair, Physics Department, University of Wisconsin-Whitewater

https://www.uww.edu/cls/cls-directory/profile?id=benjamir

"No battle plan survives first contact with the enemy." This quote is a version of an observation made in a 1871 essay by the German military strategist and Prussian Field Marshal Helmuth von Moltk. As we found, it also applies to working with eighth graders.

As part of the ongoing collaboration between the University of Wisconsin-Whitewater and the Horwitz-DeRemer Planetarium, we obtained a grant—to UW-W—to purchase a show on Supervolcanoes, narrated by famous volcanologist (?) and actor Benedict Cumberbatch. Half of the cost of the show was covered by the NASA-supported Wisconsin Space Grant Consortium, the other half was paid by the College of Letters & Sciences and the Office of Research and Sponsored Programs at the University of Wisconsin-Whitewater. This amazing show explains how supervolcanoes work, and how they have dramatically reshaped the history of life on our planet.

Two of the last three major extinction events on Earth were caused by super volcanoes. Approximately 250 million years ago, a supervolcano eruption in what is now Siberia wiped out more than 90% of the species on Earth in what is called the "Great Dying" (also the Permian-Triassic extinction). This extinction event opened up the door to the dinosaurs. A mere 40 million years later—or 210 million years ago—a second super volcano formed along the North American/European boundary as the supercontinent Panagea fragmented into the continents we know and love today. The loss of biodiversity in the Triassic-Jurassic extinction was not quite as large, and many species of dinosaurs survived to develop into the dinosaurs so beloved by school children, most notably the T-Rex.

But we all know what happened to the dinosaurs, right? Only 65 million years ago, an asteroid slammed into the Earth wiping out almost all species of dinosaurs and leaving the door open for us clever mammals.

Tying these three events together is the orbit of our Sun and Earth around the center of the Galaxy. Our Sun/Earth has made just over 18 trips around the center of the Milky Way. Everything I just described happened only in the last orbit, the Sun's most recent "Galactic Year".

My original grant called for a presentation called "The Changing Earth, The Changing Sky" to talk about how these changes have happened. I had planned to do a presentation to set the stage for the planetarium show, talking about how the constellations change over millions of years, the presences of comets and asteroids, and then what was going on here on Earth.

My original program did not go so well. When eighth graders have just gotten off a bus for a field trip, settling down to quietly listen to a lecture is not something they are predisposed to do. That's when I discovered that eight grade teachers deserve some kind of "hazard pay"; sixth and seventh graders are a walk in the park in comparison.

So we re-envisioned the whole format. First, we stunned them into silence with the awesome show on supervolcanoes, and then I followed up with my presentation. Rather than emphasizing the changes, I emphasized the danger. I focused on the grisly details of what happens after a supervolcano or after an asteroid impact. And I stressed that our civilization could be wiped out AT ANY MOMENT. That seemed to hold their attention.

As a bonus, I was able to incorporate the results from a new mission—just last fall—demonstrating how NASA is beefing up our planetary defense with things like the DART—Double Asteroid Redirection Test—mission. So for those of you who are worried about the fragility of our planet, take comfort in the fact that some of us are on it, doing our best to make sure we don't all get wiped out. Hopefully, that battle plan will be fully prepared if or when the time comes!

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INTERNATIONAL NEWS

Dear fellow planetarians...

At a time when we celebrate the centennial of the projection planetarium, our family and our domes across the World are indeed still very much alive and constantly growing and modernized with new technologies and new offers to the audience. You'll find many good examples of that below. Among others, Cyprus got its first planetarium and, in Germany, the tradition of transforming huge infrastructural buildings into planetariums has seen yet another example.

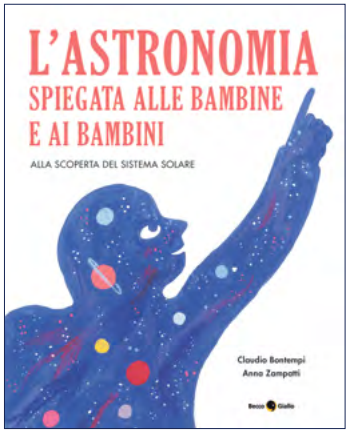
For this section I'm indebted to contributions from Loris Ramponi, Alexis Delivorias, Andreas Schmidt, Ignacio Castro, and Amie Gallagher.

Let's start this tour around the world in Southern Europe.

ITALIAN ASSOCIATION OF PLANETARIA

The text of Centennials Posters Planetarium, written by Guilherme Frederico Marranghello and Volkmar Schorcht, has also been translated into Italian. One of the 20 slides has been devoted to the Italian Planetariums. The first Italian planetarium was opened in Rome in 1928 at the Baths of Diocletian; it was one of the first outside of Germany. Closed in the 1980s, today it has a new home in the Museum of Roman Civilization in Europe. The Milan planetarium was inaugurated in 1930 and has remained open continuously ever since, except during World War II. It has a dome of 19.6 meters in diameter and is equipped with a Zeiss IV opto-mechanical projector, installed in 1968. Today, there are over 130 planetariums in Italy.

There is a large meadow with a dome resting on the ground and one raised off the ground, all framed by a belt of mountains that envelops the splendid environments of the Alpine arc. Inside the first dome there are about thirty comfortable seats for traveling in sidereal space, and in the second is a super-eye with a diameter of half a meter. We are at 1200 meters above sea level, in Trentino, under dark and transparent skies, in the location of Tesero. Francesca Limiroli of the Val di Fiemme Astronomers Group reminds us that the association celebrates its first thirty years of activity in 2023. The Observatory-Planetarium is open all year round



IAP. *(Left)* Osservatorio Val di Fiemme. Courtesy of Francesca Limiroli. *(Right)* The cover of the book L'astronomia spiegata alle bambine e ai bambini, courtesy of the BeccoGiallo Editor.

The book *Astronomy Explained to Girls and Boys: Discovering the Solar System* by Claudio Bontempi (texts) and Anna Zampatti (illustrations), was produced in collaboration with the Serafino Zani Astronomical Observatory and with the Serafino Zani Study and Research Center in Lumezzane (Brescia) on the Observatory's 30th anniversary. The author of the book presented the publication to young readers during some of the summer evenings held at the Serafino Zani Observatory of Colle San Bernardo in Lumezzane Pieve. At one of these events, a very young reader had the opportunity to sit next to the author of the book and share her impressions. In fact, among the various families present at the event, there was also a 9-year-old girl who had also participated, along with 170 other primary school pupils, in the meeting that took place at the Odeon Theater with the authors of the publication. On that occasion, girls and boys had received the book as a gift from the Municipality of Lumezzane. During the next year, all the primary schools of the municipality will be involved in the presentation of the book. The author will be in each school also to reply to the students' questions. The contents of the book will be dedicated to astronomy lessons for children that will take place at the Lumezzane Planetarium.

On its 30th anniversary, the Serafino Zani Observatory, and the local astronomical association, thanks to research in the field of asteroids (and in particular, those classified as NEO that approach the Earth), won a prize of 13,120 dollars. The prize, awarded as part of the Shoemaker Near Earth Objects (NEO) Grant Program 2023, will be used to purchase a more sensitive instrument with a wider field of view that will improve research work.

EUROPEAN/MEDITERRANEAN PLANETARIUM ASSOCIATION

Croatia

In June, July, and September, the Rijeka Astronomy Centre introduced the new *Starry Nights* package program in English into its regular program, specially designed for foreign tourists. The *Starry Nights* program is offered every Wednesday evening and includes the digital planetarium shows *SEEING!* (June), *From Earth to the Universe* (July) and *Two Small Pieces of Glass* (August),

complemented with nighttime stargazing using a laser pointer, along with telescope observation.

On 30 June, RAC celebrated International Asteroid Day in collaboration with the Rijeka Academic Astronomical Society (AAD-Rijeka), presenting the *Small Bodies of the Solar System* and *Chasing the Comets* live shows. Later that same day, AAD-Rijeka presented *Asteroids: Threat and Seed of Life* and introduced visitors to the International Astronomical Search Collaboration (IASC) project, a citizen science program which uses Pan-STARRS telescope images from Hawaii to process data and search for newly discovered asteroids. It is worth mentioning that AAD Rijeka members have been actively participating in this program in the past year.

In July, the RAC introduced its Summer Family Package with the live show, *A Guide to the Summer Night Sky*, a short planetarium show *Losing the Dark*, and night sky stargazing with a telescope. On 20 July, on the 54th anniversary of the Apollo 11 mission to the Moon, the RAC prepared the *Apollo and Artemis Twins Night* to celebrate the Apollo 11 mission and to inform the public about the Artemis Missions. The event included live planetarium shows, lectures, a quiz for children and adults, and stargazing at the center's observatory. At the time of writing, the RAC is organizing the *Prepare, Beware, Perseids!* and *Moon Party* events to be held in August, dedicated to the Perseid meteor shower and the full Moon.

Greece

Further south, the New Digital Planetarium of the Eugenides Foundation in Athens shut down on 25 June for a major technical upgrade that will drive it for many years on a top performance level. Almost everything in the planetarium was upgraded with new high-end equipment. The installation includes 8 new Christie Griffyn 4K35-RGB pure laser projectors that boost the brightness and combine to provide an almost 8K resolution image on the 24,5-meter dome. The sound system and all the lighting and automation systems have also been upgraded to the latest generation. The work was performed by Sky-Skan Europe.

Cyprus

In Cyprus, the new Tamassou & Orinis Planetarium was inaugurated officially on the 3rd of June. It is the first planetarium in Cyprus and has an 18-meter dome with an RSA Cosmos SkyExplorer digital fulldome system. A more detailed presentation of the new planetarium will follow soon.

EMPA. Outside view of the Tamassou & Orinis Planetarium in Cyprus. Courtesy of the Eugenides Foundation.

SOCIETY OF GERMAN SPEAKING PLANETARIA

Baden-Württemberg

The Science Center Experimenta, Heilbrunn celebrated the world premiere of the animated film *Der kleine Major Tom – Aufbruch ins Ungewisse* (*Young Major Tom – A Departure into the Unknown*) on April 27 with two screenings. Both screenings were accompanied by a live appearance of Peter Schilling, singer and developer of the figure, as well as an expert talk with Peter Popp, producer and director of the film. In a guest appearance, Peter Schilling, whose international hit, *Major Tom (Coming Home),* is featured in the film, took to the stage with his band. Schilling also provided the idea for the series of children's books of the same name. One adventure has now been filmed and is screening in the dome.

"I actually never dreamed that my idea of 2016 to create a young astronaut for children would become something so huge in such a short time. I am proud of the teams that worked on the project and am quite simply overwhelmed," said Schilling after his appearance.

The film was produced in cooperation between the musician and producer and director Peter Popp. The result is a unique 25-minute outer space adventure that was developed specifically for fulldome projection and targets children six years and older, school classes, and families. The film tells the exciting story of the sensitive astronaut, Tom, and his impulsive friend, Stella, who must go beyond themselves to save Earth from a great danger.

In the film, viewers learn a lot of interesting facts about space and space travel, but also the consequences of climate change for life on Earth. Impressive images taken of the Blue Planet from outer space reveal its beauty and fragility. As a gigantic hurricane speeds toward Earth, the two young astronauts must face their own personal challenges: Tom overcomes his fear and finds the courage to go on a spacewalk. Stella, meanwhile, recognizes how important mindfulness and teamwork are for a successful space mission. The audience can sympathize with Tom and Stella as they experience their dreams and disappointments, and the young main characters learn what it means to accept responsibility.

The evening of the world premiere was a resounding success: in addition to guests of honor and the press, families with children were invited to attend who clearly enjoyed the film, concert and expert talk. Autographs from Peter Schilling were especially in demand, as were pictures with the "Walking Act," a large plush figure of Major Tom.

"Being able to experience a movie premiere at Experimenta is a true highlight. It was wonderful to see how enthusiastic the audience was. It was very important to us to find new formats for children that present topics such as space travel and sustainability in an age-appropriate and fun way,"

GDP. Der kleine Major Tom show premiere. Der kleine Major Tom show premiere with Peter Schilling. Show premiere production team photo. All courtesy of Experimenta Heilbronn.

says Prof. Dr. Bärbel Renner, managing director of Experimenta, in summing up her impressions of the premiere.

Berlin

In commemoration of the first projection planetarium, which began operation on 7 May 1925 in Munich, the International Day of Planetariums was celebrated this year. The Stiftung Planetarium Berlin marked this special day with the most popular programs for children and families. Visitors enjoyed *With Rockets to Planets* in the planetarium dome, a tour through the universe in *Starry Nights*, and an adventurous journey to the moon in *Armstrong*. Furthermore, *The Three ??? and the Singing Snake* offered a 3D radio play experience.

In the evening, a free livestream was available featuring an event by the European Space Agency (ESA) in collaboration with the Society of German-Speaking Planetariums (GDP) on the JUICE mission by ESA, broadcasted in 360° fulldome format in the planetarium dome of the Zeiss-Großplanetarium. The focus of the evening event was the current space mission JUICE (Jupiter Icy Moons Explorer). ESA representatives of the JUICE mission, Dr. Christian Erd (spacecraft & system engineering manager) and Ignacio Tanco (spacecraft operations manager), reported on the research objectives, challenges, and hopes arising from the over seven-year journey of the spacecraft to the gas giant Jupiter and its largest moons.

The roadshow *Universe on Tour* by the Federal Ministry of Education and Research (BMBF) is a collaboration between the Stiftung Planetarium Berlin, the Astronomical Society, the Association of Star Friends, the Society of German-Speaking Planetariums, and the House of Astronomy. Since 10 May, it has been touring across Germany. A fascinating 360° program in the dome of the mobile planetarium takes visitors on a journey into space in a total of 15 cities, starting from observing the sky with the naked eye, through the invention of the telescope, to modern astronomy. An interactive accompanying exhibition provides information about the significance of light as an information carrier and the impact of light pollution on the environment, population, and astronomy. Participatory activities like the citizen science project Nachtlicht-BüHNE (Nightlight Stage) foster the interaction between researchers and interested citizens. Admission to the roadshow and the exhibition is free. The Stiftung Planetarium Berlin was the initiator and organizer of *Universe on Tour*. It visualizes the planetarium program, which incorporates local research institutions at each location and showcases their current research results as part of an ever-changing program in the mobile dome. Tim Florian Horn, president of the Stiftung Planetarium Berlin, expressed his excitement: "I am thrilled that with *Universe on Tour* we can bring our wonderful cosmos with impressive 360° programs to people who otherwise don't have a planetarium near them. This is a great collaborative project involving many different institutions under the umbrella of the *Science Year 2023 – Our Universe* by the BMBF". The *Science Year 2023 – Our Universe* is an initiative of the Federal Ministry of Education and Research.

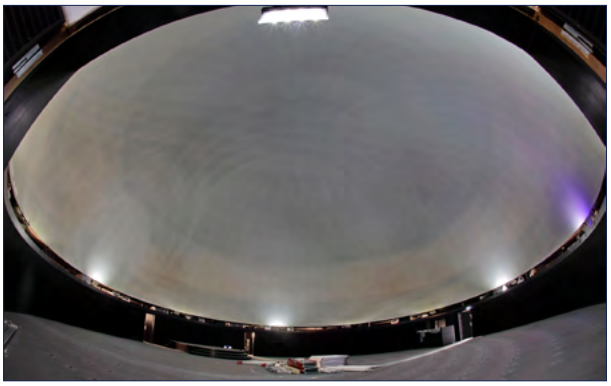
Starry sky in new splendor - The Zeiss-Großplanetarium celebrated

GDP. Universe On Tour. Courtesy of Christina Czybik.

GDP. Wilhelm Foerster Sternwarte: Drone image. Courtesy of SPB, Volker Gehrmann.

reopening after an LED upgrade. With the LED upgrade, a new PC cluster, dome cleaning, and reduced power consumption, the Zeiss-Großplanetarium has dressed up for summer and the future together with ZEISS. The immersive planetarium experience, including a deceptively real starry sky, is created with the star projector (the heart of the planetarium), planet projectors, and 360° fulldome projections. The dome-filling projection consists of a digital projection system with ten ZEISS Velvet video projectors that offer 8K resolution. The video projectors were converted to LED as part of the upgrade and now have higher brightness, lower noise level, and significantly lower power consumption. The 23-meter dome of the planetarium has also been thoroughly cleaned so that the Universe can shine in high gloss again. A new high-performance PC cluster with UNIVIEW Open Dome enable an even more brilliant fulldome experience. The Zeiss-Großplanetarium, one of the four astronomical facilities under the umbrella of the Stiftung Planetarium Berlin, was the most visited planetarium in the German-speaking world in 2022 with 288,054 guests. Since its modernization in 2016, it has been one of Europe's most modern science theatres.

The Planetarium am Insulaner in Berlin-Schöneberg opened on 16 June 1965 and has attracted nearly six million visitors. Now it is time for an extensive modernization with a view to the future. Starting on 9 July 2023, the facility will be transformed into a visionary educational center as part of extensive renovation and modernization work, bringing the technology up to date. In addition to a new star projector, the planetarium hall will be equipped with modern fulldome technology and a new projection dome, among other things. There will also be ample space for innovative educational formats, such as Cosmos labs, where students can learn to visualize scientific data and engage in interaction and discussion. The building will also undergo external changes and return to its original form with an open entrance area in accordance with the monument protection guidelines. The Planetarium am Insulaner has stood at the foot of the eponymous hill since 1965, offering impressive 360° events, astronomical live lectures, audio plays, readings, music, and children's programs under a 20-meter dome. Sky observations have been carried out at the neighboring Wilhelm-Foerster-Observatory since 1963, and the observatory will remain open. Both facilities, along with the Archenhold-Observatory and the Zeiss-Großplanetarium, are part of the Stiftung Planetarium Berlin.



GDP. Zeiss-Großplanetarium maintenance. Courtesy of Pedro Becerra.

GDP. Planetarium am Insulaner - Visualization. Courtesy by SPB.

Austria

In 2001, the planetarium in Schwaz, Tyrol was opened in a newly constructed building. For more than 20 years, visitors enjoyed various shows about the stars and our universe. High-end, high-precision optical equipment and 360-degree video equipment in the dome brought these shows to life. From 2015 onwards, the idea emerged to enhance the planetarium by integrating the latest technology. The vision was to create an adventure dome with a convertible 360-degree dome that allowed a broader scope of experiences. Visitors would immerse themselves into various worlds, explore them, discover new perspectives, and experience a magical blend of image & sound in the perfect combination of entertainment and communication of knowledge.

In 2020, actual planning commenced. Thanks to the pandemic, there was suddenly enough time and space to explore this in detail. Within a few months, an entirely new operational concept was designed, business plans were written, technology partners were contacted, and a strategy was developed on how to transform the planetarium into YOUR DOME Tyrol. The final plans included state-of-the-art projection technology as well as a redesign of the shop, café, and outdoor facilities. Renovations were completed in spring 2023 and on 11 May, the well-kept secret was finally presented to the media and public.

"We want every visitor to experience his or her very special moment. Our program offers a wide range of experiences people can choose from: watching breathtaking movie scenes with a unique 360-degree view, delightful family time, or encounters with other like-minded people," says Axel Krieger, CEO of Axel Krieger Edutainment. Mastermind Krieger has more than 30 years of expertise and experience in operating tourism and entertainment institutions. This knowledge motivated and inspired him to transform the planetarium into YOUR DOME, saying, "Most people visit a planetarium in their childhood and maybe a second time with their

children or grandchildren. The multi-faceted YOUR DOME program offers incentives to visit repeatedly."

A new, seamless screen with109 white aluminum panels with 0.8-millimeter perforations are perfectly tailored and fitted into the dome hemisphere. The new aluminum screen is the centerpiece of YOUR DOME. The 4K projection equipment provides seamless 360-degree projections onto a perfect surface. The integrated sound system completes the magical imagery with splendid, space filling sound. The seats, arranged in semi-circles and the semi-circle bench at the rear wall, accommodate up to 60 visitors, depending on the kind of screening. The seats can be removed from the room upon request, thus providing space for performances that require the visitors to lie on their backs and enjoy a direct view towards the ceiling. With a small stage in the room, comfortable seating, and a free area with the impressive 360-degree projection screen above, YOUR DOME is more than a special kind of cinema. It quickly transforms into a versatile event location for private events and exclusive groups – for exceptional company and product presentations. Further information at: www.yourdome.tirol.

GDP. The new YOUR DOME in Schwaz. All courtesy of Ines Entleitner.

Saxony-Anhalt

This spring, a new planetarium opened in the city of Halle in Eastern Germany. The remnants of an old gasometer were chosen to host the new dome. This industrial monument was in use between 1892 and 1972 as a tank of the old municipal gasworks. It remained an impressive brick wall building over 30 m in diameter and 16 meters high in ideal surroundings, Situated directly on the national German bike trail within a wide recreation area on a green island in the river Saale near the city center of Halle. The four-year construction period between 2019 and 2023 is documented in a 45-minute film bearing the title *Himmelsmaschine – ein neues Planetarium entsteht*, which could be translated as *The Sky Machine – a New Planetarium is Being Built*. This film is available at www.ardmediathek.de. The film led to an upswing in people's interest in astronomy and planetariums within and outside the region and was followed by an unbroken influx of audience to Halle Planetarium with sold-out shows during the first three months after its opening.

Approaching the building, a graffito on the outside attracts the visitor's eye. It is over one hundred meters long and up to two meters high. This "annual band of zodiac constellations" covering a full year's ecliptic cycle puzzles the visitor with an obvious departure from usual expectations. The aim was to stir up controversy by placing the well-known constellation figures into the month when they are visible during the night sky rather than into the month six month later, when the Sun resides within the same constellation during daytime. The graffito of constellations also has an effective deterring function towards self-proclaimed graffiti artists.

On the inside, there is the 12-meter dome offering up to 110 seats arranged in a concentric pattern with the possibility of rearranging the mobile seating in the southern hemisphere of the hall to support a unidirectional view. Seats can be temporarily removed to the number of 80 for events like concerts or theatre performances requiring a larger stage area. In accordance with the hundred-years-old planetarium tradition, the star projector resides in the middle of the dome. It is a liftable Zeiss Skymaster ZKP 4 LED supported by six velvet projectors located behind the ranks. Several projection systems bring astronomical content into the dome. A sound system with 42 loudspeakers distributed evenly around the dome completes the planetarium technology.

Furthermore, the planetarium houses an RC24 telescope with an aperture of 600 mm, placed on the roof of the building, as well as an additional solar telescope. It is possible to transmit both telescopes' shots to the dome in real time. This allows a large group of people to "see through the telescope" at the same time. Another highlight is the observation platform of 200 square meters. It is somewhat lowered, embedded in the building and shielded from direct city lights by a surrounding glass wall, and is therefore ideal for observation with mobile telescopes and open-air events. Two fully equipped lecture halls, a library with literature on astronomical subjects, several administrative offices, and a state-of-the-art production studio with a

GDP. Inside the dome of Planetarium Halle. Courtesy of Thomas Ziegler, Stadt Halle (Saale)

GDP. Telescope of Planetarium Halle. Courtesy of Christian Schoenherr, Stadt Halle (Saale).

GDP. Opening of Planetarium Halle. Courtesy of Thomas Ziegler, Stadt Halle (Saale).

soundproof speaker booth provide further possibilities for events, study, and production of full dome content.

A team of six planetarians, led by Dirk Schlesier, former managing director of Planetarium Wolfsburg, takes care of the operation including educational, cultural, and entertainment events with about 22 public shows per week on school weeks and additional shows in the morning during school holidays. The educational concept includes an average of 12 live performances on astronomical subjects for school classes per week. These performances are supported by schoolteachers, as this is one of only three federal states in Germany with compulsory astronomy lessons in all schools. Halle Planetarium maintains extensive partnerships with educational institutions like schools, colleges, universities, and vocational schools but also with theatres, astronomical associations, museums, and other institutions like the German National Academy of Sciences, Leopoldina. Two different groups of youth, the YoungStars and the ASTROlinos, have their regular home in Halle Planetarium.

The opening festivities covered over 30 events and attracted 3,000 visitors over four days, starting with an educational live program for children. The events were accompanied by several music ensembles, among them the Stadtsingechor, a boys' choir with a tradition of over 900 years (one of the oldest town choirs). Members of the Symphony Orchestra Staatskapelle and the Opera House of Halle performed star related baroque arias. *Latina Brass*, an excellent young brass formation, as well as a puppet show for our youngest visitors, were also included. An award ceremony for the most successful participants at the young researchers' competition, Jugend Forscht was musically embellished by award winners of the young musicians' competition, Jugend Musiziert of the state of Saxony-Anhalt, bringing together successful young talents in science and art. In just the first three months of its existence, the Halle Planetarium attracted 30,000 visitors.

There are several works of art within the walls of the former gasometer. One of them is an installation of a graduate of the Burg Giebichenstein Art Academy, Etienne Dietzel. He won the Competition Kunst am Bau (art in architecture / construction sides) with his installation *As Far as the Eye Can See*. His installation consists of a bookshelf with 6,000 books (the number of stars visible to the naked eye in the clear night sky) arranged in 25 rows of 240 books each. As an ensemble, the colored spines of the books are intended to convey an impression of the cosmic background radiation. These are guest books that, when filled, are placed back anywhere on the shelf again, thus further changing the installation over time. Another work of art in Halle Planetarium is Marc Fromm's expansive installation, *Floating New Ways,* which shows a family of astronauts. It represents a plea for a peaceful coexistence between people and should encourage a more careful handling of our world – goals that are also conveyed in the planetary educational work.

It has been fantastic for the staff to open a new planetarium almost 100 years after the presentation of the first projection planetarium and hence to enrich the planetarium landscape, true to the motto, "The stars were just the beginning."

ASSOCIATION OF MEXICAN PLANETARIUMS

If you are planning to observe the annular solar eclipse on 14 October 2023, the Yucatan peninsula might be a good choice. And afterwards, you may escape to the beautiful white sandy beaches of Cancún! In Merida, Yucatan an Eclipse Committee 2023-2024, Mexico under the Moon´s Shadow has been integrated by several institutions such as the Arcadio Poveda Ricalde Planetariun in Merida, Yucatan, UNAM's local branch, and more Yucatan government agencies. The committee will have two sites in Merida and three more in other populated areas. The Yucatan Astronomical Society (Yucatan Autonomus University) will have five sites throughout Merida and nearby inhabited areas like Dzibilehaltum. Another astronomical society, ESIA Ticoman, will participate with a site at

the Hacienda San Nicolas Dzuyuche in the municipality of Merida. All of them will observe the eclipse, providing the local population with safe guidelines to observe the phenomena. The Chetumal Planetarium in Quintana Roo will also be in the annular 90.34% totality path.

Regarding other subjects, AMPAC is planning to have its annual meeting in Tepezalá, Aguascalientes in October 2023 (dates still to be decided at the time of writing).

MIDDLE ATLANTIC PLANETARIUM SOCIETY

MAPS held officer elections earlier this year. As of 1 June, Noreen Grice takes the helm as president. Brian Koehler is past-president, and Tony Kilgore is president-elect. Mike Francis and Amie Gallagher continue their roles as treasurer and secretary, respectively.

The Middle Atlantic Planetarium Society was delighted to participate in the Stars for All Conference in Kingsport, Tennessee in June. Approximately 60 of their members joined about 300 planetarians from around the United States, plus some international colleagues, for a week of professional development and camaraderie.

MAPS presented its highest professional award, the Distinguished Service Award, to Steve Russo. This is a special recognition for outstanding, long-term service and dedication to the planetarium field on a local, regional, or national basis. Nominees exhibit qualities of leadership, inspiration, vision, commitment to excellence, and a passion for the planetarium community.

April Whitt received the MAPS Exceptional Service Award in appreciation of her work as president of the organization. MAPS Fellows Awards were presented to Carolyn Slivinski, Stephen Dubois, Mike Francis, Mark Percy, and Noreen Grice.

April Whitt left her fancy dress for the Stars for All Gala banquet at home by mistake, and was instantly befriended by Oana Jones, who offered "to wear jeans too, in solidarity." Both she and Francine had brought their fancy dresses and were willing to go casual. Great friends!

People on the move: Joyce "JT" Towne formed Omnidirectional Consulting and now works as an independent consultant for planetarium projects.

MAPS. MAPS President Noreen Grice, MAPS member Sam Storch who presented the award, and Steve Russo, award recipient. Courtesy of Amie Callagher.

MAPS. (Top) New MAPS fellows: C. Slivinski, S. Dubois, M. Francis, M. Percy N. Grice. Courtesy of MAPS.

MAPS. (Above) Jeans Dames (see text). Francine Jackson, Oana Jones, April Whitt. Courtesy of April Whitt.


ROCKET BUILDER TO MARS
INTERACTIVE EXHIBIT
MISSION:
REACH SPACE
ENGINEER A ROCKET THAT CAN REACH THE EDGE OF SPACE
REACH ORBIT
MAINTAIN A LOW-EARTH ORBIT
REACH MARS
CONDUCT A TRANSFER BURN TO MARS FROM LOW-EARTH ORBIT
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INTERACTIVE EXHIBITS | FULLDOME SHOWS | MUSIC SHOWS

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TALES FROM DOME UNDER
MY SILENT OFFICE PARTNER

I'm not sure if it was just plain luck, or it happened to work out that way, but I never had to share an office with another staffer all my years working in planetariums. As it turned out, I left the Swedish Museum of Natural History (*Naturhistoriska riksmuseet*) right before there was to be a major reorganization plan to bring the Public Department our Cosmonova theater was a part of into an "open office" setting.

There was a large space in one of the Museum's non-public, behind-the-scenes areas that someone felt was necessary to stuff with desks for staffers. And this in spite of the fact we had very little to do when it came to interacting with other people in the Department. At around the same time, there were any number of articles and reports, based on research, showing open office schemes didn't work. In fact, they cut down on productivity. Why would you want that?

What was even more daft was that it would put all of our technicians behind desks there, leaving only the one on duty in the theater's projection room to run shows. If any sort of a serious problem presented itself, it meant any other help would be delayed while other techs made their way to the theater from this open office area, which was in another wing of the building.

As anyone who has been responsible for producing planetarium shows knows, it can require large amounts of quiet time in order to be able to think. Or, at least I, the only producer, found this to be the best way to get my proverbial production ducks in a row.

During the last years I was at Cosmonova, however, I ended up with one unique office partner, though he really was the silent type. We got along just fine.

During 1999-2000, my wife, Mariana Back, had a year of leave from her museum, the Swedish National Museum of Science and Technology (*Tekniska museet*), to work at my museum. While

Mariana Back's collection

there, her task was to conceptualize and produce a brand-new exhibit called "*expedition rymden*" ("Expedition Space").

There had been several other space-related exhibits in our museum's past, but this was going to be a totally new effort, not one that had been dusted off from storage and then "tricked out" a little with a couple of new items. One of the things, however, that looked promising to use from an earlier exhibit was a replica of an Apollo space suit. Unfortunately, it had been damaged in storage, which had gone unreported for what was probably years. Somewhere along the way, someone had accidentally spilled a large quantity of bright blue paint down the back and one side of the suit. What was worse, its helmet, complete with a gold-colored visor, had been cracked into pieces like an eggshell, rendering it unusable. There was also an Apollo PLSS (Primary Life Support System) backpack, which would have been used by a real astronaut during an EVA on the surface of the Moon. That, too, had the same blue paint on it. Fortunately, the suit's lunar EVA gloves and the Backpack Control Box mounted on its chest, were undamaged.

Since there was no helmet, Mariana got the idea to have an "astronaut" made to go inside it; their head would be seen as if they had just popped the outer EVA and inner pressure helmets off. The question then became who would undertake this task.

Fortunately, there was a local practical (i.e., physical) special effects company in Stockholm that showed promise. Not only did they like space, but they were also big fans of the Apollo missions, so it seemed like a (wait for it…) "match made in space." They could not only restore the EVA suit back to its original condition, sans helmet, but they could also make some EVA boots to go with it (and insert the head of an astronaut).

Having visited their downtown office once on another project, I knew these guys were really hard-core space enthusiasts. They had even built a large-scale table-top model of the Lunar Module, which was detailed to the N^{th} degree. This was certainly nothing I expected to find in Sweden, but it just goes to show you the universal appeal of human spaceflight.

If there was to be an astronaut inside it, the question then became, who should they be? Mariana and I are both big fans of the late Al Bean (1932 - 2018), who was the Lunar Module pilot on Apollo 12. Over the years, we had collected some of Bean's signed art prints. Not only was he a talented artist, but he was also just a really nice guy. This mission in and of itself was special too. While Apollo 11 was important in showing that we humans could land on the Moon, this second flight proved that it could be done again. Not only that, but Bean and Commander Pete Conrad (1930 - 1999) made a precision landing on 19 November 1969 within just 163 m (535 feet) of one of the key parts of their mission; the Surveyor 3 lunar lander. This not only meant that NASA could plan more such pinpoint landings to interesting sites in the future, but it also allowed Bean and Conrad to remove parts of Surveyor, which were brought back to Earth for study. This was no accident or stroke of luck. The retrieval of these parts, as well as collecting some of the lunar rocks that Surveyor had imaged, was planned. What better way to study the long-term effects on spacecraft materials in this harsh environment than by having physical samples from one that had stood on the lunar surface for about two years? It was the first and only time that we humans visited anything we left on another world.

Both Surveyor's television camera and the extendable arm, with its surface-soil sampling-scoop, were on display at the Smithsonian's National Air and Space Museum. Its TV camera had, in fact, made the first image of Earth from the surface of the Moon.

The decision was made that the new astronaut head modeled for the inside of the refurbished Apollo EVA suit would be that of Al Bean. One couldn't just "borrow" his likeness without permission, so Bean was contacted and gave his wholehearted approval for the project. I can imagine that he was also amused by the request.

Of the entire space suit restoration, Al's face was the most fascinating. It was not modeled in something hard, like a show room dummy, but was soft and spongey, like real skin. His eye color was matched from photographs, and even the eyebrows and any hair showing was individually punched, strand-by-strand, into the "skin" as if it were a figure at Madame Tussaud's Wax Museum. A newly made black "Snoopy cap," complete with little stem microphone, was placed on top of his head.

To complete the suit, an Apollo 12 mission patch was silk-screened onto a piece of beta cloth for the front of the suit, as was an American flag on the left arm at the shoulder. A label, just like on the backs of the original Apollo PLSS backpacks, was made with his name on it. The metal clip, used for mounting a Hasselblad 120-format lunar camera on the front of the Backpack Control Box, was included. Last, but not least, they also made a pair of the Apollo lunar boots that so famously made thousands of slatted footprints on the surface of Earth's nearest neighbor in space.

The finished "Al" was rather heavy, and required some hip-mounted guidewires to hold him upright on the circular, industrial metal platform he stood on inside of a large Plexiglas cylinder. In early astronaut vernacular, he looked better than the usual "spam in a can."

After a number of years, the "*expedition rymden*" exhibit was taken down and the question became what to do with good ol' "Al." Long interested in the Apollo program, I offered that he could come and hang out with me in my office. To my delight, the Exhibits Department agreed.

Here is the finished mannequin of Apollo 12's "Al Bean" standing just inside the entrance to the "expedition rymden" exhibit. The entryway just past him is how you entered. The elevator-like doors opened, visitors stepped inside, and the doors closed behind them. After a short little sound and motion experience, the doors on the other side of the entryway opened and you were onboard the exhibit's "space station." (Picture: Exhibit designer Andrew Stone, via Mariana Back)

Here's a picture of "Al" and I in my Cosmonova office before he was remounted on his metal base. You can just make out the Apollo 12 mission patch on the right side of the Backpack Control Box mounted on his chest. Unfortunately, this photo doesn't do the detail work in his face justice. I already mentioned that those hairs on his face, like the eyebrows, were individually punched into the soft skin. (Photo: the author's collection)

One day, I was down working in the Digistar programming room, which was next to the theater projection room. This is where we had our DEC mini-computer, graphics processor, and a keyboard/monitor so I could do offline Digistar I programming while the theater was in operation. After a while, I had a phone call from our offices upstairs. Some of the museum's support staff had just "...left an astronaut in your office."

Racing upstairs, I found this expensive, life-sized model of a larger-than-life space hero unceremoniously dumped on my office floor. Where his PVC pipe "legs" had been fastened into the base through his shoes had literally been ripped apart, tearing through the two pipes, making the screws mounting holes unusable. And there was no base. After trying to stand him up by leaning him against a wall, I realized that I needed the meter-wide round metal base or he would be spending his retirement days laying down. I placed a call to the Exhibits Department and they seemed only too glad to get rid of that too. The base showed up in my office right before lunch.; now all I had to do was bring the two parts back together again.

Torgny Bång, one of our technicians, gladly came up after we got back from lunch armed with an electric screwdriver and some shiny new metal screws. In no time, "Al" was back on his feet again, and, after getting his guidewires refastened, was as stable vertically as he was before. The best part was that there was no Plexiglas cylinder around him, which had taken up quite a lot of space.

The last time I was in that office was my last day of work at Cosmonova; 29 February 2011. I have no idea what happened to my astronaut buddy after that. There was the possibility that he was going to be brought over to *Tekniska museet* to be part of something space-related, but alas, that never came to be.

Speculations have been made by others about whether or not androids dream of electric sheep. Does this highly-detailed model of an Apollo astronaut—wherever he is today—dream of his days shuffling around in the lunar regolith with his friend, Pete Conrad, or of his time spent later onboard Skylab, America's first space station? Perhaps we'll never know as he's not talking.

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MOBILE NEWS NETWORK
OUTREACH WITH A MOBILE DOME

On 13 May 2023 a zoom meeting was held with 50 people from 13 States and 18 Countries (USA, Canada, Paraguay, France, Germany, Brazil, Hungary, Finland, England, Northern Ireland, Australia, Italy, India, Chile, Costa Rica, Portugal, Sweden, Morocco, and the United Arab Emirates). Attendees included long time directors, newbie's, wannabees, retirees, producers, inventers, and manufacturers of mobile planetariums.

After a welcome from Susan Button (IPS Portable Planetarium Committee Chair) and Marco Avalos (Zoom Host), Michael McConville, IPS President, welcomed everyone and complimented us for the important work we do. He discussed IPS membership opportunities for mobile domes and the special centennial two-year membership for the price of one year. *https://www.ips-planetarium.org/page/howtojoin*

After that we discussed ways in which the International Planetarium Society (IPS) can support mobile planetariums

- Committee Webpage
- *Mobile News Network* 1990- Present *https://www.ips-planetarium.org/page/plntrnarchive*
- Analyze the need for better fulldome content when applicable, and feasible ways to get it: Shorter videos, lower pricing, group buying power, and free content and software
- A list of *Resources for Content* has been posted on the IPS Portable

Planetarium Committee webpage and it will be updated as needed.

Lionel Ruiz reported that Pablo Carlos Budassi's artwork is now available for the digital dome and that he has agreed to make some of the 4K images free to planetariums. Pablo is very happy to have portable planetarium operators share his work with their audiences. Also, he has offered to work with a volunteer fulldome artist to animate some of his work. In return, the artist will receive free licenses to the animations. Lionel said that he is willing to help in adapting this content to fulldome application or making an immersive video by zooming in this content (with adapted resolution). Pablo's work can be adapted to be played as a video in two directions with Lionel's free fulldome player (also available on Windows now). Lionel was able to demonstrate this during the meeting using Pablo's content directly.

IPS held a contest, with several monetary grants as prizes, to help realize the best ideas for activities, exhibitions, shows, inclusive materials and much more during the centennial celebration from 2023 to 2025. 16 winners were chosen and several of them are mobile dome operators! Four of them were in attendance at this meeting. They each made a presentation. *https://planetarium100.org/.../sixteen-projects-awarded/*

Presentations:

(All of the winning project details/presentations will be released in the future for the planetarium community to benefit from these creative initiatives.)

- Balázs Forgács – '*How to manage large open events with Mobile planetariums*' (Hungary)
- Rodrigo Madariaga - '*Tikva Mobile Planetarium*' (Chile)
- March Avalos Dittel - '*Celebrating the Centennial of the Planetarium*' (Costa Rica)
- Bryant Gonzalez Vasquez '*The First Mobile Planetarium Project in Paraguay*' (Paraguay)

Marco Avalos then led a discussion about best practices, what has worked, and what has not (Fulldome films/live). The general consensus was that live interaction is ideal and, if using video, very short films and clips work best.

The committee tried to set up a working group on the IPS Committee page but so far it cannot be open to nonmembers. Many agreed to register to the small planetariums mailing list at small-planetarium@groups.io.

The recording of this meeting can be found at: *https://drive.google.com/drive/shared-with-me?q=type:video* (we are trying to post it to the IPS YouTube channel)

Future projects:

We would like to include a history of portables on our committee page and make a presentation about it at the 2024 conference in Berlin. (At the meeting in May, Phil Sadler agreed to provide additional information about the STARLAB transformation to digital projectors.) Another presentation we will offer addresses how to work with very young children in the mobile dome. (Babies to 6 years old)

Another critical topic we will work on is developing a low-cost solution for mobile planetariums; we will support collaboration on any homemade options being explored.

We are making a more concerted effort to find mobile domes worldwide. Daniel Audeon has developed a map of all the portables he is aware of, including the attendees of the May meeting. *https://planetariums-database.org/index.php?menu=mobiles* To encourage more data, the form for Daniel's Worldwide database is now linked to the Portable Planetarium Webpage. *https://planetariums-database.org/index.php?menu=form*

We will have future zoom meetings four times a year. The next meeting will be 9 September 2023. You don't need to be an active member of IPS to attend our meetings. We will provide a Zoom meeting link for everyone who is interested.

StarLight Un planetario Tra le dita- Perugia, Italy

The website reads: "This is what the APS '*StarLight, a planetarium between your fingers*' proposes, presenting educational

and popular initiatives to the world's schools and the public, developed and validated during the many years of activity in the field of astronomy as teachers, planetarians and/or laboratory technicians. Educational and laboratory courses are carried out at the school facilities, while the events intended for the public and the observations of the sky are organized in suitably chosen places." *http://www.starlightgroup.it/*

This summer I was in Italy for a family wedding and, since we were staying very near to Perugia, my daughter and I had the pleasure of visiting with my dear friend, Simonetta Ercoli, as she gave us a full day personal tour of her beautiful city. When specifically pressed to her work with StarLight, Simonetta led us to the one remaining tower in town. She led us up 237 steps to the top where, on the terrace of the Sciri Tower, we had a magnificent view of the entire city. On this terrace, Simonetta and her former students help citizens of their city to observe the sun with solar glasses, a sunscope, and a telescope. Participants discover solar midday with merinto and Hindu circles, test a solar oven, and finally taste pizza cooked with the heat of the sun! During other events, they can explore the beauty and mysteries of the moon, stars, and planets. Simonetta is also one of the very valuable hosts for the IPS "American in Italy" contest. All participants who have visited and worked with her cannot say enough about what a wonderful host she is and how extraordinary their time with her was.

PPA Mini Grant: Nico van der Merwe from Sutherland Planetarium (South Africa)

In August 2020, the Pacific Planetarium Association donated $400 towards Nico's astrophotography project. The idea was to purchase photography equipment to take time-lapse photos (with a fisheye lens) of the Southern Skies from the South

Counterclockwise from left: Simonetta and Susan on the terrace of Sciri Tower *Credit: Photo by Laura Reynolds*. Laura and Susan and the tower. Sciri Tower is about 42 meters high and is the only surviving tower of the original dozen that previously existed in the city of Perugia. These towers were a symbol of the noble prestige of the most eminent city families. The Sciri Tower was probably built around the end of the XIII Century. *Credit: Photo by Simonetta Ercoli.* Simonetta and Susan at a wonderful lunch spot. What's not to love about delicious Italian cuisine with good friends?! *Credit: Photo by Laura Reynolds*

African Astronomical Observatory in Sutherland. These photos/videos would be made available freely for anyone to download and use.

After some time (Nico had to save some funds), a secondhand Nikon D5300 camera with photography equipment and editing software was purchased. Several time laps videos were created and uploaded to Nico's YouTube channel.

During this period, Nico was approached by AFAS to form part of a working group with the sole purpose of developing an affordable mobile planetarium for the African continent. Nico started working on an affordable fisheye projector concept. Ultimately, the camera setup originally earmarked for astrophotography ended up being used to capture and compare the output of different projector and lens combinations. The combination of the fisheye lens with a higher resolution camera made it possible for Nico to share his results with the rest of the working group (located across Africa).

The funds earmarked for a camera that was originally meant for astrophotography ended up being used to help develop an affordable fisheye projector that can be used in smaller/mobile planetariums.

The Projector concept that looks the most promising can be manufactured for under $1000.

Once the affordable mobile planetarium project has been completed, time and energy will be redirected towards creating amazing time-lapse videos (center of the Milky Way season is fast approaching).

https://www.youtube.com/watch?v=WOOuQBWTS6A (about the 26 minutes point - Nico Van der Merwe from Sutherland Planetarium (South Africa) talks about his Sutherland Planetarium (http://www.sutherlandplanetarium.co.za), a fisheye lens astrophotography project to make time-lapse photos of the southern skies and make freely available for anyone to download and use, and a project developing an affordable fisheye projector and mobile planetarium for the African continent.)

This is the projector he used in a test setup (it is similar to the ones he uses in his planetarium):

https://www.amazon.com/BenQ-Theater-Projector-TH671ST-Ambient/dp/B076MHKTFH/ref=sr_1_1?dchild=1&keywords=benq+th671st&qid=1608537412&sr=8-1

The auxiliary lens:

https://www.amazon.com/Xit-XT1458F-0-14x-Super-Fisheye/dp/B00B49LNRK/ref=sr_1_1?dchild=1&keywords=0.14x+auxiliary&qid=1608537493&sr=8-1

With the 0.14x auxiliary lens, Nico is able to cover approximately 90-95% of my 8.4m dome. He reports that the focus looks pretty good across the entire dome; the 3000lumens seems sufficient for this size dome. His next step will be to develop a permanent attachment for the lens onto the projector and perhaps try and get a 4k projector.

African Planetarium Association *Rising Star:*

"The South African produced planetarium film, *'Rising Star'* has been added to the ESO Astronomy full-dome content database and is now available for international downloads via their website: https://www.eso.org/public/videos/rising-star/

The film, accessible to all ages, premiered on 19 October 2020 at the Iziko Planetarium and Digital Dome in Cape Town, and was supported by the SAAO and SARAO. It offers the viewer an engaging and fully immersive glimpse into the world of South African astronomy, and highlights the many remarkable facilities hosted in the country, along with some of their latest results. This includes views of the Southern African Large Telescope, and the most powerful radio telescope in the Southern Hemisphere, MeerKAT.

As the first of its kind to be produced in Africa, *'Rising Star'* hopes to stimulate the production of many more locally produced planetarium films, popularize Africa's numerous scientific achievements, and inspire the next generation of astronomers.

Read more here: https://supernova.eso.org/news/announcements/ann22004/"

Small and portable planetarium consortium:

For some time, an effort has been made to pull together a group of planetarians to form a consortium for mobile and small dome folks purchasing content at a group rate. Things are finally coming together; nine people are interested and two vendors have agreed to work with us, Hubblo (https://hubblo.ca/en/) and Adler (https://sites.google.com/adlerplanetarium.org/adlerproductions). If you are interested, the details are still being worked out and maybe you can join, or we can form other groups interested in the same idea.

Engaging Our Communities (con't.)

I hope I have convinced you that reaching out and collaborating with diverse communities is worthwhile and important. The groundwork takes time, but the rewards are priceless and long lasting. Your planetarium can become a place in which you offer programs that welcome more people, attract more diverse staff, and better understand people with different backgrounds. This work is just one step towards contributing to a more inclusive planetarium environment.

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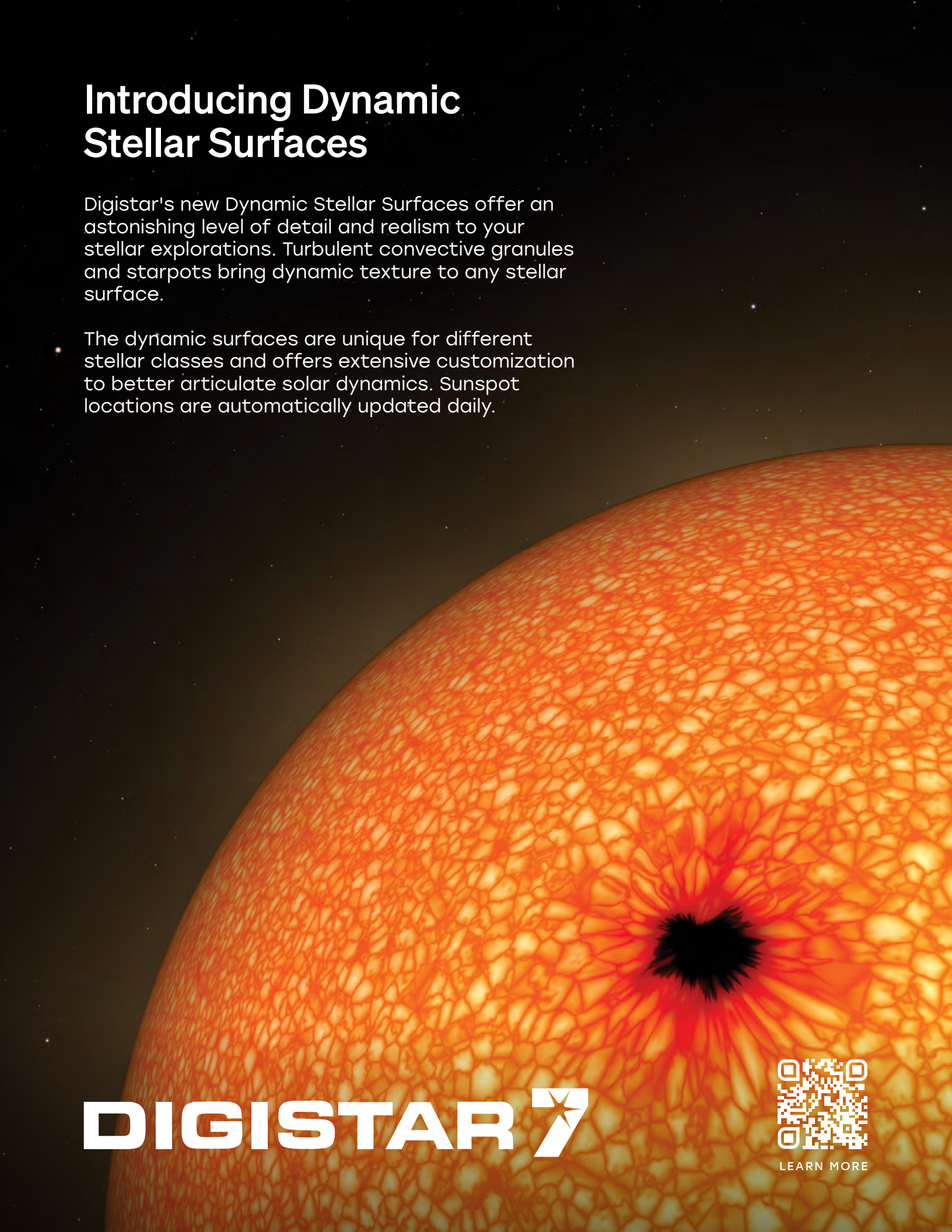
Introducing Dynamic Stellar Surfaces

Digistar's new Dynamic Stellar Surfaces offer an astonishing level of detail and realism to your stellar explorations. Turbulent convective granules and starpots bring dynamic texture to any stellar surface.

The dynamic surfaces are unique for different stellar classes and offers extensive customization to better articulate solar dynamics. Sunspot locations are automatically updated daily.



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LIP SERVICE

STARS FOR ALL MINI LIPS RECAP

As you're reading this, LIPS 2023 is likely underway. LIPS 2023 is being hosted by the Michigan Science Center (MiSci) in Detroit, Michigan USA. It takes place Tuesday through Thursday, September 12 through 14. I I will write about what happened at LIPS 2023 in my next column.

In this column I want to discuss a recent Mini LIPS. In late June, more than 300 people flocked to Bays Mountain Park and Planetarium in Kingsport, Tennessee for the Stars for All Conference. This was the second national US planetarium conference; the first was called the Pleiades and took place in St. Louis, Missouri in 2017.

Due to the projected size of the Stars for All conference, I expanded the Mini LIPS size from a maximum of 40 to a maximum of 60 attendees. We ended up with about 50 attendees, which felt like a great size for the room we were in.

We started the day off with a workshop entitled "*Building Depth Through Storylines: Why Can't We Walk Through Walls?*" This was led by Dr. Chris Moore of the University of Nebraska Omaha, and it focused on the importance of a compelling narrative to transmit information. As to the answer to the title question, let's just say that it is complicated.

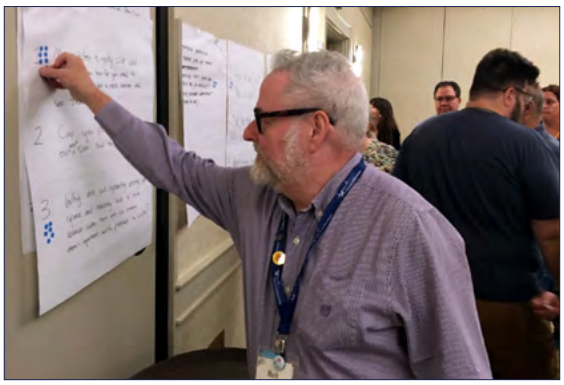
After the opening workshop, I led a session that I have done a few times in the past with the amazing Sara Schultz from the University of Minnesota-Moorhead. This "*Asking the Right Questions? How to Maximize Your Audience Engagement*" session is based on Sara's doctoral research concerning the use of questions for formative assessment, which assesses throughout a lesson rather than just at the end.

We discussed how and when we use questions in programs, the differences between open and closed questions, and more. After some small and large group discussions, a few brave individuals each did a brief presentation where they concentrated especially on the timing and type of questions they used. Unfortunately, Sara was not able to come to Stars for All due to a family emergency, and we all missed her. I'm sure she would have loved seeing the wonderful presentations!

Next, I assisted Alan Gould, formerly of the Lawrence Hall of Science's Holt Planetarium, in a session entitled "*Tackling Difficult Questions*." Alan is one of the key figures in audience-driven planetarium programs, and I always learn something new watching him in action. It was an honor to co-present with him.

Alan and I first split the audience into small groups, and we gave them the assignment to think of questions and comments they've received during programs that they find really difficult to answer. After generating these, we instructed groups to narrow their lists down to no more than three questions or comments. Each small group then shared their list with the entire group, and we crossed out any duplicate entries.

We purposely split this session into two parts, with lunch in the middle. During lunch, people were instructed to vote on the three questions or comments they most wanted to have someone ask during a presentation. After counting the votes each question or comment received, we ended up with six that received far more votes than the others. We put these six in a hat so that we could draw one during each presentation.



(From top) Elliot Severn was one of the intrepid presenters during the "Tackling Difficult Questions" session. Mark Webb casting a vote for a difficult question. Attendees reviewing the many difficult questions and comments before making their selections. The audience enjoyed Dr. Chris Moore's opening workshop about the importance of storylines in presentations. All images by Ian McLennan; used with permission.

We worked in small groups to reimagine constellations during Richard Gelderman's "Putting the Stars into the Hands of Our Audience" session. Image by Ian McLennan; used with permission.

Volunteer presenters put their name in a different hat, and they were instructed to present on a topic of their choosing. We selected someone from the audience to ask a randomly drawn difficult question whenever they wished, as long as it was within the first minute of the presentation. The whole group then shared ideas about how that question or comment was addressed.

I always commend people who are willing to get up and present in front of an entire group, but this time I was exceptionally proud of our presenters. They volunteered even though they knew in advance that they would be getting a difficult question—and they knew that they would not know what the question was until it was asked. All of our presenters fielded the questions and comments well, and the conversations these presentations sparked were some of the best I've ever heard at a LIPS-style event.

Next, my co-worker Kat Hunt led a session looking at how we can encourage experts in science subjects to better communicate their knowledge to our audiences. From avoiding jargon and long, complicated words to ideas for effectively interacting with planetarium visitors, this session provided some valuable insights on how to make a guest presentation resonate with our audiences.

Richard Gelderman, formerly of the Hardin Planetarium at Western Kentucky University, then took us through an activity where small groups make their own constellations in his session "*Putting the Stars into the Hands of Our Audience.*"

Each small group was handed a paper with a familiar pattern, such as Cassiopeia or the Big Dipper. In our groups we created a new interpretation of those stars and came up with a short tale about how our constellation came to be in the sky. Richard shared some valuable strategies about how he remembers which group created each constellation, since he had 10 small groups at the Mini LIPS. It can be tough to remember which group said what!

And finally, we ended the day discussing the Great Lakes Planetarium Association's project, "*Live From the Planetarium: the Sequel.*" Sara Schultz was going to present this since she is spearheading it, but as she couldn't attend, I shared her slides.

If you are not familiar with this, it is an update of an earlier project where several presenters sent in clips of themselves presenting live programs, and then two hosts discussed what they observed about each clip: *https://glpa.org/resources/professional-development-resources/live-from-the-planetarium/*

My thanks to Jean Creighton of the University of Wisconsin-Milwaukee for jumping in during the Mini LIPS to discuss the original *Live From the Planetarium* project! Jean was one of those two hosts who commented on clips, and she was able to provide much more detail than I could. Hopefully this little bit of publicity will lead to more clips being submitted to Sara and her team.

So what did the attendees think about the Mini LIPS day? I always have people complete a short evaluation after each LIPS-style event. These evaluations are anonymous so that people are free to say whatever they wish. Here are some of the comments we received:

- Loved the variety of feedback and group participation.
- This is so fantastic—teaching teachers!
- My favorite part was the part about dealing with difficult questions. It's so hard to do, especially these days when people seem so quick to anger. I think having a part 2 where de-escalation techniques are discussed would also be beneficial. (NOTE: I agree that this is a fantastic idea!)
- These sessions are usually my favorite part of planetarium conferences.
- Love this every year! Will keep coming back!
- I really enjoyed the interactions and discussions throughout the day.
- This was much more interactive and provided more concrete modeling/examples—loved it!

I want to give an extra huge thank you to my fantastic co-workers, Kat Hunt and Diana Yoder, for helping organize and run the Mini LIPS, and to Ian McLennan for taking so many great photos. Without Ian's pictures, this would have been a very bland column; I'm always too distracted during the day to take pictures myself.

And finally, I thank everyone who attended and participated so actively and generously throughout the day. We couldn't have done it without you!

As always, I end this column with reminders about the LIPS Google Group, Live Interactive Planetarium Symposium Facebook group, and the LIPS team chat. Contact me (*karrie@DigitalisEducation.com*) if you need information about any of these, or if you'd like to share any ideas or feedback.

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A DIFFERENT POINT OF VIEW
A LITTLE BIT OF EVERYTHING

Coincidence:

As I get older, I find myself suffering from more and more afflictions, the latest being "Pareidolia." I've been told not to worry as most people have it and it is wired into our brains one way or another. Is that why I see ants when I look at a barbell type planetarium projector?

Then there is "OCD" - what a nasty affliction. It manifests in me mostly when I lock a door and then wonder, "Did I turn the light out?????" So, I open the door and sure enough the light is out. I could probably force myself to quit this insanity except for that one time (three years ago or so) that I reopened the door a few days later and the light was still on. So now I push the light switch down and say off for at least a half dozen times and keep saying off-off-off as I lock the door. That usually ends it as I have yet to ask myself why I'm saying "off" for.

But "coincidence' is another thing altogether. The address of the house I grew up in on the south side of Chicago was 2024. Back in the 1950's I wondered if I would live long enough to reach that actual year. Little did I know that there would be a total eclipse of the sun that was close enough to see. Little did I know the planetarium projector would be one hundred years old. Little did I know that I would operate a functioning planetarium. Little did I know that my age would reach the last and fastest record speed (78 for those that don't remember record speeds) and here I was, a youngster who had yet to reach the first talking book record speed of 16 2/3. This is when the mysteries of the operation of the Zeiss II at the Adler first began occupying neurons in my brain. As I age, the synapses up there don't connect as often as I would like, but if I wait long enough, they eventually do.

Enough, anyway, the point of all this is that there appears to be more "little did I knows" then I can write off to just "coincidence." I guess 2024 must be respected more than the average year, which boils down to my little attempts at star projection. So what can I do for this centennial that is different? It came to me, not in a dream (which would have been nice), but in an everyday synapse connection while I was saying "off" for the fiftieth time. My special program will compare the projection of the various projectors I've collected over the years. While I tend to doubt anyone would come to such a program (cynicism has grown with age) I will then photograph the dome and have a comparison of the various projector outputs. I will call it, "From the Spitz Jr. to the Minolta IIB: a Study in Light." Where it will be "published," I cannot say as there is probably very little interest. Oh well, it will keep me busy.

Keith's Captured Quips ~ Chapter Twenty- Four

"I loved how you showed the stars in the huge thing."

"My favorite part was when the Bear was on the roof....Well I have to go But thank you any way."

"...when it got dark, I was scared. But, when I saw the wonderful stars, it looked very – very cool. Also the bear was even better then the stars before."

"I'm so grateful that the Planetarium was built because without it I woudn't have known a lot about space."

"I am grateful for the grate day you gave me. I have to go now."

10 years ago (September 2013):

Now these are the kind of stories I really enjoy. Richard Sanderson tells the story of the Seymour Planetarium as it celebrates seventy-five years running on a home-built projector designed and built by the Korkosz brothers. I should say eighty-five years and the projector is still going strong. Even with adding a fulldome video projection system, the staff here has decided to keep the eighty-five-year-old projector operating.

One of the things I've always liked about the old barbell in the center of the room is that a show could be produced for very little money. Sharon Shanks wonders about the cost of fulldome programs for planetariums with little or no money and how the fiscal gulf between big production and small budgets could be bridged.

She tells the story of Jerry Grayson, who just produced his first IMAX film. It cost $4 million (in 2013 dollars) and Sharon suggested $3,000 as a comfortable budget amount, that means he'd have to sell it to 1,333 venues to break even. Well, I'm an odd duck but I could never come up with that kind of money for a show and Jerry wondered if she could come up with ten venues who would pay $3K he would be very happy. Needless to say this did not come to pass.

Many of us must do with duct tape and WD-40 to keep our shows on the dome. Sharon sums it up beautifully, "We do the best we can with the tools we have and carry on. And, as I wrestle with writing about today's world, it seems all too possible that 99 percent of us, the planetariums who have a harder time every year finding funding, will all be Vandalia one day: operating by passion and duct tape alone, until the passion is beaten out of us or our equipment fails. Yes, that's pessimism at its finest."

(Vandalia, a cash-strapped rustbelt town and the equally cash-strapped middle school planetarium.) Some might say I've done a disservice by taking a lot of this out of context, so please go to page four of September 2013 and read the full article.

25 years ago (September 1998):

Some of you might wonder why anyone would want to review twenty-five-year-old material. After all, who cares that the first Laser Disc was offered by the IPS. With modern computers, why try and keep a LD player alive. True, much of the information in these older issues is perhaps more nostalgic than anything else, unless perhaps you don't have

a budget for the latest and greatest. However, if you look deep enough you will find gems like "Planetarium Promotion 101" by Christopher Reed. "An Introduction to Marketing for the Planetarium Professional" is well worth reading as sometimes good ideas are lost and could be useful once again.

Richard McColman's column "Planetechnica talks about light pollution in the planetarium. Not the kind you might assume, which actually can be generated with a small flashlight bulb, but the kind generated by the high light output of a slide projector. Since light pollution is actually a way to brighten slide projection but tends to destroy any dark adaptation required for a star show. The author recommends making a reducing aperture plate to place in front of the lens to cut back on the light from the projected image. The only problem I've run into (yes, some of us still use slide projectors) is the light from the back of the projectors cooling system, especially if the projector is inside the dome. I have found that a ten or twenty watt or so LED lamp replacing the normal projection lamp works very well.

45 years ago (September 1978):

I love scripts, as they often stimulate one to generate new ones for their own planetarium. Ronald N. Hartman's "Script Section" offers us a script by the H. R. MacMillan Planetarium entitled, "Whatever Happened to Krypton, The Missing Planet?" Now I'm not too sure how many of you want to do a star show based on a DC comic, but then again, there are some places that show movies all the time. This, however, was back in a time when star shows were the norm rather than the exception.

This segues into an article by Walter Bisard called, "Evaluation: Where Does It Fit into Your Planetarium?" This is geared more toward any exhibit space around your main dome. Some of the exhibits might be a bit old, like the large globe in a dark corner, but it appears to generate a substantial amount of interest (at least back then). If you remember having one, it might still be on display or waiting to come back to the exhibit floor from a dark storage place in the basement or behind the dome. The point being that new generations will enjoy old exhibits that they have never seen before. Make use of what you have and choose...wisely.

For those of us really poor people who still use Edmund one rpm motors, I will direct you to Herb Schwartz's, "Creative Corner" which will tell you how to motorize mirrors.

And back then Saturn had only ten moons and Pluto was a full-fledged planet.

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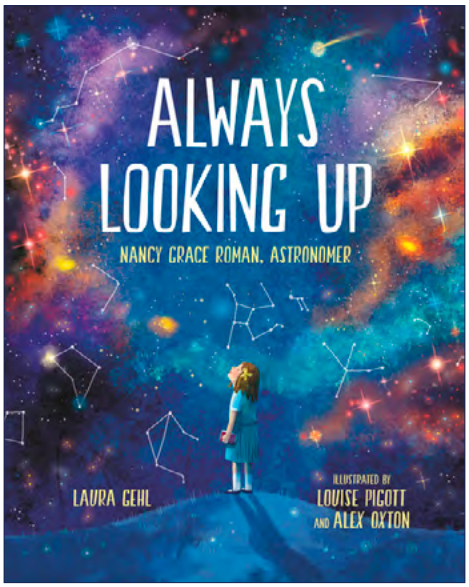
BOOK REVIEWS
NEW IN THE WORLD OF LIT



Always Looking Up: Nancy Grace Roman, Astronomer

By Laura Gehl, illustrated by Louise Pigott and Alex Oxton, Chicago: Albert Whitman& Company, 2019, ISBN 978-0-8975-0296-9, hardbound, US$16.99.

Reviewed by Francine Jackson, Ladd Observatory, Providence, Rhode Island, USA.

Most of us know that a new telescope is being launched to study, among many subjects of astronomy, dark matter and dark energy, exoplanets, and the infrared universe, in the mid 2020s. It is named for Nancy Grace Roman. But, is everyone familiar with who she was, and why this incredible machine is being launched with her name on it?

This tiny book, suitable for the very young, as well as adults looking for information on this incredible woman, is written for all to enjoy. It introduces Nancy Grace as a young girl who, like many women in the twentieth century, was discouraged from becoming a scientist. In addition, as a young girl, she had very weak eyesight, preventing her from truly enjoying the sky she loved so much. However, Roman was able to overcome both obstacles, soon becoming one of the top astronomers at NASA.

Her first major project was attempting to convince NASA, and Congress, of the need for a telescope that would observe above the atmosphere; over a decade later, the Hubble Space Telescope left Earth, and is still returning magnificent images.

Throughout her life, Roman stayed focused on her mission: Studying the stars every clear night and watching their motions through space. Even after retiring, she kept up with the latest developments in astronomy, lectured to both children and adults, and continued to look up at the sky as often as possible.

Although this book is considered one for a young reader, an adult who is totally unaware of Nancy Grace Roman and her many achievements will gladly take an afternoon to read of her many accomplishments, despite the struggles she had as a young woman. Once you read Always Looking Up, you will realize that naming the next space telescope after her is a perfect choice.

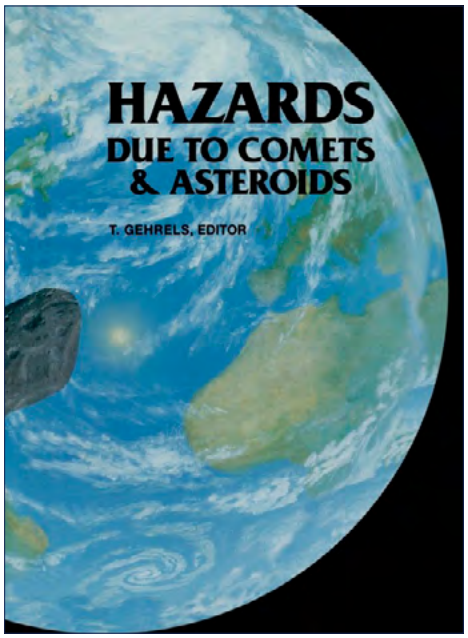
Hazards Due to Comets & Asteroids

By T. Gehrels, editor, The University of Arizona Press, 1994, ISBN 0-8165-1505-0

Reviewed by Robin Byrne

When I was given the opportunity to review a book about the impact hazards from comets and asteroids, I thought it would be fun. Then the 1234-page monster, edited by Tom Gehrels arrived in my mailbox, and I was terrified … and confused! The book is a collection of journal articles written in 1994(!) in response to the realization that large impacts could still occur, as evidenced by the Shoemaker-Levy collision with Jupiter. Not having the time to peruse such an imposing (and outdated) book, I chose to read the abstracts for each article, and to scan samplings from a few.

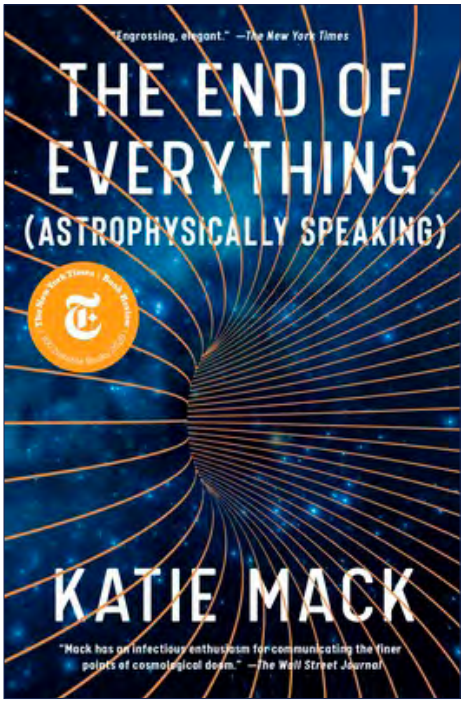
The volume is arranged into eight parts, covering everything from describing the impacting bodies to how to search for near Earth objects, their physical characteristics, the advantages



of people traveling to these objects, the effects from impacts of various sized bodies, possible methods for deflecting the impactors, and ending with some philosophical considerations. Comprised of 46 articles written by a total of 120 authors, there's a plethora of information in this volume. There were two articles in the philosophical section that really stood out for me. One was co-written by four authors, including Carl Sagan. In this chapter, they evaluated the odds of a globally destructive impact versus the odds of humankind abusing the technology developed to deflect such an impactor. Their conclusion was that we would likely annihilate ourselves with that technology long before a similar-sized threat arrived from space. In another article, the author discussed whether the expense involved in developing technology to prevent a rare catastrophe couldn't be better spent addressing more pressing societal needs. Both chapters had ideas that were very thought-provoking.

I'm not sure why this column's editor believed this one would be a good book to donate for review, given that it was published 29 years ago. However, while some of the information is outdated,

there is much that remains relevant. The general premise that there is a need to identify potentially hazardous objects is still relevant. Similarly, studying possible methods for deflecting asteroids and comets is continuing, as evidenced by the recent DART mission, which successfully altered the orbit of Dimorphos. All-in-all, though, unless you are a glutton for such things, I doubt this book would be a good choice to sit down and read cover-to-cover. On the other hand, as a resource, Hazards Due to Comets & Asteroids would be handy for looking up relevant information.



Dear Galileo,: Letters From A Contemporary Astronomy to His Hero

By James S. Sweitzer and Catherine M. Sweitzer, Chicago, Science Communications Consultants, LLC, 2021, ISBN 979-8-9851709-1-7, paperbound, US$25.00.

Reviewed by April Whitt, Atlanta, Georgia, USA.

What did you do during the COVID pandemic and lockdown? Teach through Zoom? Learn some new technology? Struggle to balance dome and home?

Jim and Cathy Sweitzer wrote a book. This delightful little tome comes in the form of letters written to Galileo Galilei, describing what astronomers have learned over the last four centuries, using telescopes and newer technology.

Beginning with introductions and an imaginary letter from Galileo to his student Vincenzo Viviani, we trace the heavenly objects familiar to Galileo – the Moon, Sun, and closer planets – out through our solar system and the Milky Way to exoplanets, island universes, other famed scientists, and to the dark edges. I particularly enjoyed the Elemental Facts letter, highlighting the bonds between chemistry and astronomy.

Illustrated throughout with photographs, diagrams, and drawings (some by the author), this book is perfect for gift shops, as a textbook for general astronomy classes, or a good read, whether in a lockdown or downtime.

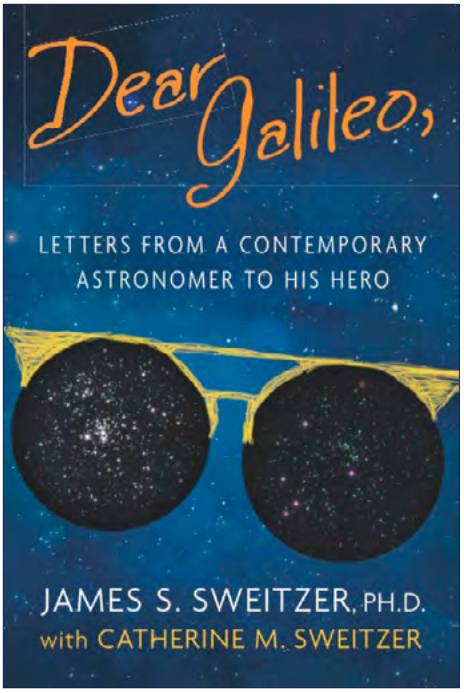
The End of Everything (Astronomically Speaking)

By Katie Mack, New York: Scribner, 2020, ISBN 978-1-9821-0355-2, paperbound, US$17.00.

Reviewed by Francine Jackson, Ladd Observatory, Providence, Rhode Island, USA.

It seems we are always asked how the Earth will end, but, surprisingly, no one seems to worry about the end of the entire universe. That is, except the astrophysicists, and the author is definitely one of them. In language easily understood by non-scientists, Mack introduces the idea that there are several ways that the universe eventually will be no more.

Each chapter introduces one concept that is studied by scientists on how – or will it? - the universe will end. Of course, to get there initially, she has to first consider how it got here in the first place. She introduces the cosmic background, and how its existence was confirmed by scientists working both for the phone company and theorists at Princeton. From there, the reader progresses into the creation of everything, and then. . .

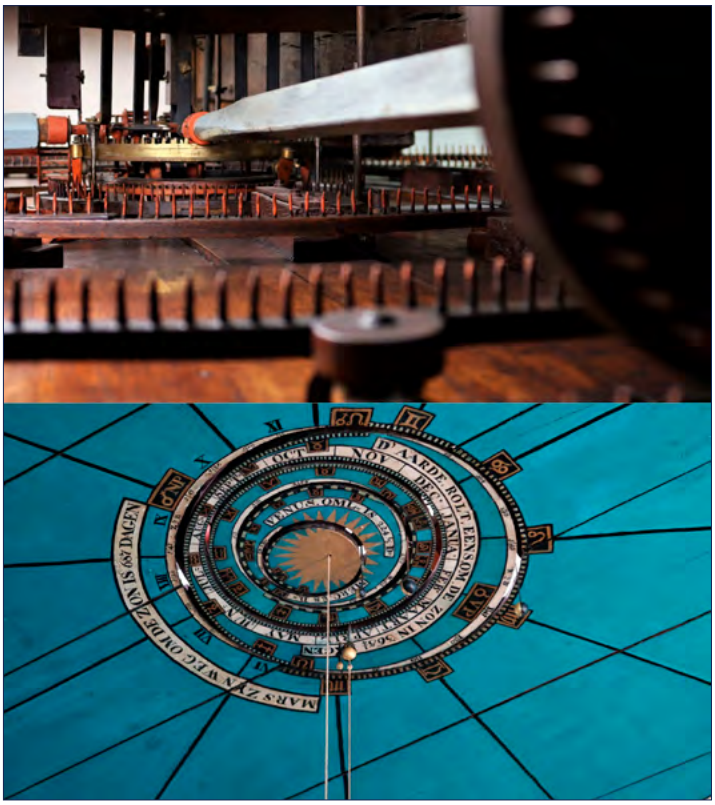


As we are aware, everything "born" has to have an end time, but is that true with the universe as a whole? Apparently, it is, and we are introduced to several possibilities: The universe's expansion could create galaxies being "dragged" such that they will slowly fade into darkness. Or it appears as if dark energy could be a major factor in changing the entire universe. Or, what about vacuum decay? Of course, there still is the concept that we may be in the middle of a "bounce."

The author clearly explains how each of these endings might be the one we have to worry about. However, any way it may happen, we really don't have to worry too much, as it seems (hopefully) the universe will be around for quite a long time, but to understand what might be the end of the universe as we know it is quite comforting, especially as we do know it won't be happening in any of our lifetimes.

The End of Everything is a good read, for anyone who is interested in the concept of the future of the universe. The author takes what could be a difficult subject and turns it into a fairly easy-to-read introduction to astrophysics. For a non-scientist, it may require reading a bit slowly, but the understanding will come very soon.

Report on Italy (con't.)



Top: Some of the inner workings of the central part of the oldest functioning orrery, the Eise Eisinga Planetarium in Franeker, The Netherlands. The clockworks and gears are located in an attic space. Above: Looking up at the inner solar system as depicted by the orrery at the Eise Eisinga Planetarium.

during that blur, I'd misplaced my backpack. Thankfully, Ivan Prandelli, local amateur astronomer and our volunteer driver and guide for the day, cheerfully undertook yet another round trip between Brescia and Lumezzane to retrieve it. The backpack, with all my camera equipment still safely inside, was reunited with me at the stroke of midnight. Whew!

During the Q&A session in Lumezzane, all the inquiries were thoughtful and characteristically enthusiastic, but one particular question especially delighted me. A student asked: "Why do you think learning this is important?" This very question is one I enjoy posing to students. I had done just that after leading the orrery activity with a homeschool group in Perugia a week earlier, so I was ready with my answer.

I talked about how people can easily go through life *without* understanding what I'd just demonstrated. We don't *need* to know how the solar system works. It may not affect our day-to-day decisions to know that we live in a galaxy with countless stars and a universe with countless galaxies. But knowledge—any knowledge—can provide context about our existence so we can more fully understand the big picture. And there is no bigger picture than the universe. Understanding the cosmos gives us an even greater sense of who we are, a sense of belonging. And when we feel like we belong, be it within a family, a social group, a city, a species, or a planet of 9 million species, our life has a greater sense of purpose and meaning.

Tutte le cose belle devono finire: Brembate di Sopra

All Good Things Must End: Brembate di Sopra

Our last day with the program was far more leisurely. Yet another new host, Marzia Albani, picked us up and drove the hour or so to her science center in Brembate di Sopra, a suburb of Bergamo. Each time we left one host for another, I found myself thinking that our new host couldn't possibly live up to the kindness of the previous one. By now, you think I would have learned. All our hosts were singularly kind and generous people, each in their own way. This was certainly true of Marzia as well.

La Torre del Sole (The Tower of the Sun) is an impressive place for science education. The facility was built at the site of an old municipal water tower. In a brilliant combination of community vision and civic accomplishment, the tower was saved from demolition and converted into a solar telescope, with the science center constructed in the surrounding area below it. Now operating for 15 years, La Torre del Sole provides broad experiences for visiting school groups and the public. Having the good fortune to visit on a sunny day, we sat in on presentations in a room at the base of the tower that serves as a viewing and demonstration area. There, live images of the sun can be projected. This is where I interacted with school groups. Likewise, the tower itself, now an observatory with a 300-mm refractor accompanying the solar telescope, has seating areas for visiting groups. Elsewhere there are activity areas, a flatscreen theater, and an 8-meter planetarium dome with a digital system that was updated shortly after my visit.

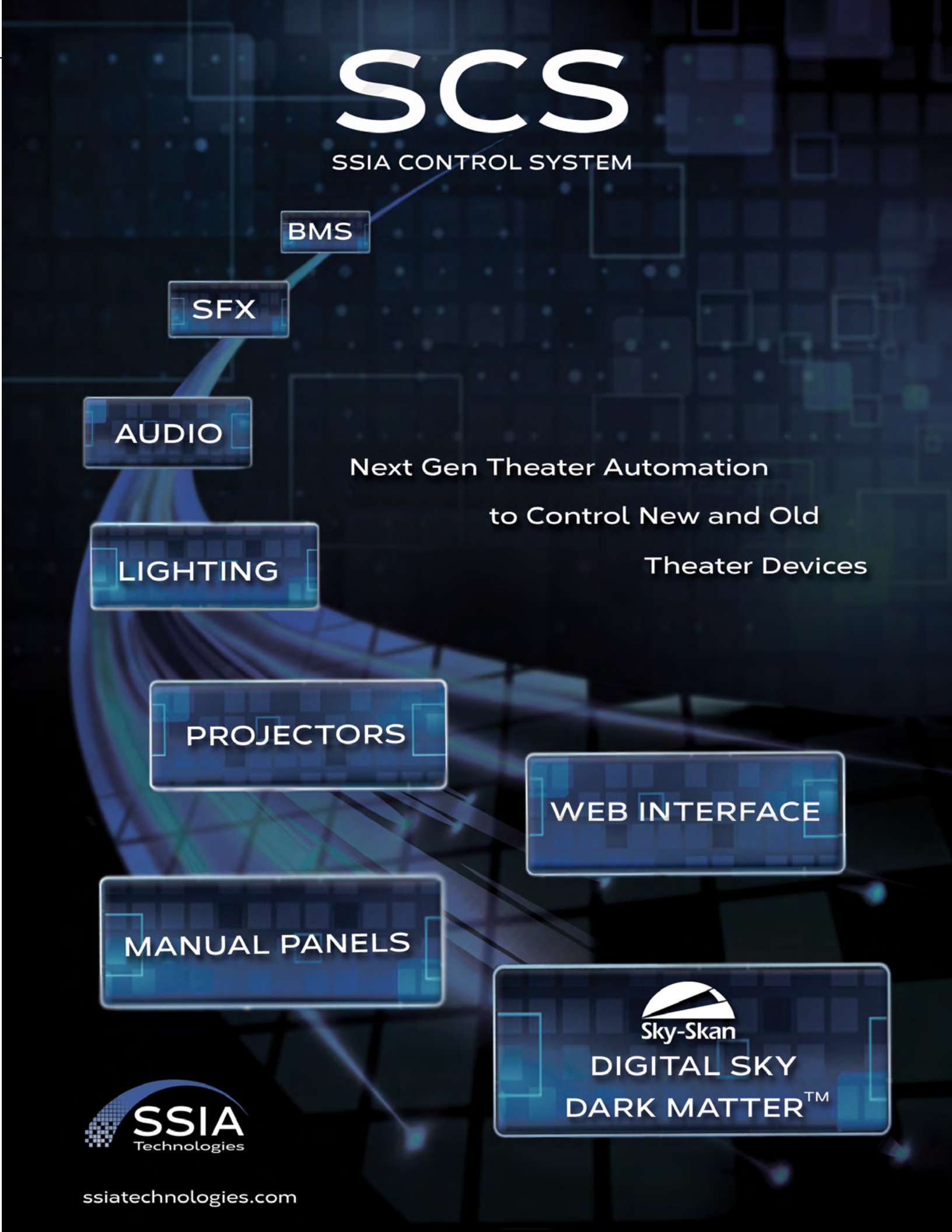
These many aspects of the facility operate due to the well-coordinated effort of a team of skilled educators. Although I didn't lead any activities during my visit, I came away inspired both by the array of experiences this center provides and the camaraderie among Marzia and her colleagues. Before coming to Italy, I wondered whether the materials I brought with me would even be used after I left them at my last stop. As if written in the stars, La Torre del Sole was the ideal place to make use of them. I spent the afternoon of that last day talking Marzia through my two principal activities, leaving those materials, along with all of the extras, in her capable hands. She was delighted to receive them, as they had been looking for new activities to use during their upcoming summer programs.

At the end of the day, with the program now concluded, Marzia generously drove us 30 minutes up into the mountains. I chose an Airbnb for the night along the Bremba River in the town of San Pellegrino Terme, yes, home of the sparkling water April and I sipped with our lunch three and half years earlier. Here, we ended this 10-day adventure that had taken nearly four years to come to fruition. Over an incredible dinner, we made a toast with local wine, saluting the realization of this dream and the opportunity to live it.

Coda: Eise Eisinga Planetarium

After leaving Italy, we spent a few days in the Netherlands. I'm not a big fan of the term "bucket list," but ever since hearing about the Eise Eisinga Planetarium in Franeker, I

(Continued on pg. 68)


SCS
SSIA CONTROL SYSTEM
BMS
SFX
AUDIO
LIGHTING
PROJECTORS
MANUAL PANELS
Next Gen Theater Automation
to Control New and Old
Theater Devices
WEB INTERFACE
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DIGITAL SKY
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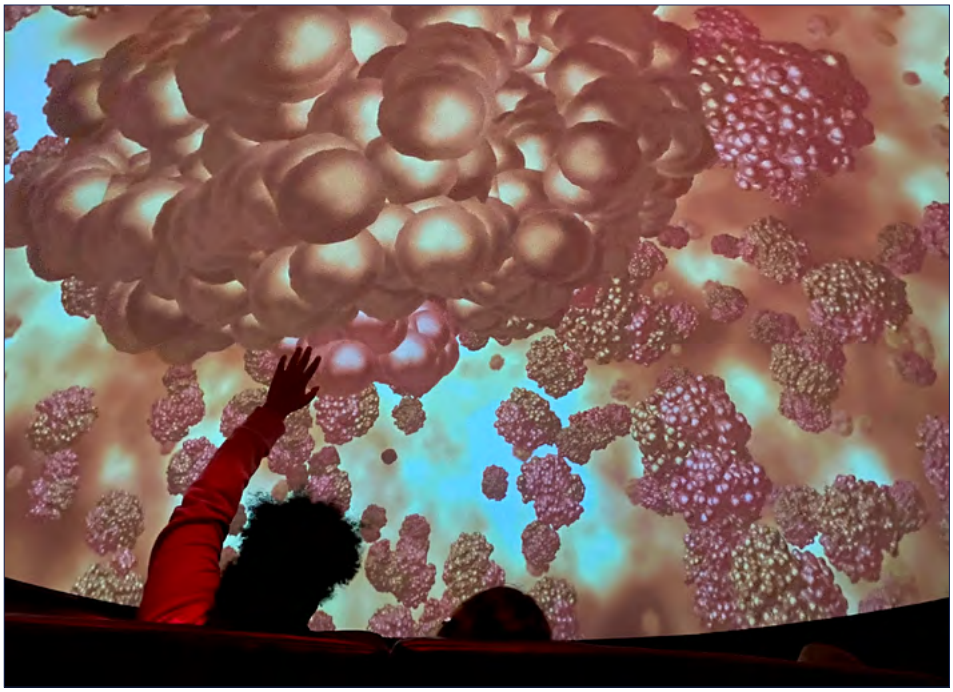
SEEKING WHAT WORKS:
REACHING BEYOND THE STARS: OTHER DISCIPLINES IN THE PLANETARIUM



The Lawrence Hall of Science; Exploring Biotechnology (2022-)

For me, planetariums will always have the night sky at heart. But it's inspiring to hear about non-traditional uses of domes in education, especially where these attract new audiences and offer new ways to learn. Evidence of such activity can be found as far back as the1950s[1]. Some planetaria may be restricted to astronomy and space topics by charitable mission or choose to stay within this subject area for other reasons. However, it feels like such domes are increasingly in the minority. Inspiring examples of non-astronomy educational presentations are frequently discussed at planetarium conferences, and fulldome films present an ever-broadening range of topics.

"Being in a dome is like being in another world – you really are immersed in the experience, and it can be any experience." Ben Brown, Explorer Dome (UK).

The intention of this article is to provide a record of some of the ways domes have been used for the teaching of non-astronomy subjects. I will focus on shows with little or no astronomy content, to demonstrate more clearly the ability of the planetarium to provide a unique teaching environment for subjects beyond astronomy. I will further restrict myself to activities where (i) the purpose is primarily educational, with explicit teaching involved, (ii) the learning takes place inside the dome, and (iii) the dome's unique properties are required for the learning experience.

This tight definition means I will not be discussing primarily cultural *performances* (e.g., music, dance, theatre) that lack an explicit educational message. Neither will I include activities which could be replicated in a classroom, or where the planetarium experience is used only as inspiration for later, dome-independent learning activities. I will however include educational fulldome films, which demonstrate the variety of visuals now available.

Finally, I will be using the term "astronomy" very broadly—and rather arbitrarily—to refer to topics I consider to be traditional planetarium topics commonly found in space-science curricula. By this definition, "astronomy" will be taken to include constellations, astrophysics, careers, planetary science, cosmology, satellites, and spacecraft. Non-astronomy topics will include constellation myths but only if the myths themselves are the subject being studied.

I will be presenting a variety of examples of educational non-astronomy dome activities, which I have divided into three broad categories:

- Astronomy as motivation for learning in other disciplines.
- Astronomy as a meaningful context for learning in other disciplines.

Astronomy is not a significant aspect of the activity, which is focused on other disciplines.

My examples will not represent an unbiased nor comprehensive survey. For a start, nearly all my examples use the English language, and many are from the UK. There will be many more non-astronomy shows out there which are not acknowledged in this article! However, I hope these examples will give a flavour of what is possible and might act as inspiration for those innovators who want to take their domes beyond astronomy.

1. Astronomy shows as motivation for learning in other disciplines

Many shows didn't meet my strict criteria as learning was independent of the dome, taking place after learners had watched an astronomy show. However, I did find two excellent examples.

Foreign language students can practice their comprehension skills by watching films in the language they

are studying. **The Buhl Planetarium**, Buhl Science Centre, Pennsylvania USA ran such shows from the 1950's until its closure in 1991, using translations provided by the language teachers.

The **Unipampa Planetarium** in Brazil also offers foreign language shows, using producer-provided soundtracks. Teachers are given a link to watch the show online in advance of the visit so they can prepare students for unusual vocabulary.

2. Astronomy as a meaningful context for learning in other disciplines

This is perhaps the most frequent way that other disciplines are encountered in the dome.

Many planetarium shows are multidisciplinary, bridging other disciplines. For example, the live-presented *Bird Orientation from Celestial Clues* (1978) is described in an early copy of *The Planetarian*, and the fulldome film *We are Stars* (2015) includes chemistry and biological evolution. But sometimes the other discipline is the main subject being communicated, despite the story being packaged as a 'space' show.

Teaching a different discipline within an astronomical context is not only a way to attract new audiences into the dome, but also a way to provide school groups with required curriculum links during periods of study when space may not be on their curriculum at all.

Explorer Dome (UK) offer their live, physics-focused *Forces Show* (ages 5-11 years) and *Light Show* (ages up to 14 years) to schools in their mobile domes, using space as a hook for these topics.

Examples of fulldome films that use astronomy as a context for other science and maths topics include *Zula Patrol: under the weather* (2007); *Earth's Wild Ride* (Earth science, 2015); *Astronaut* (human biology, 2006, 2012); *La Luz, Más Allá del Brillo y el Color* (light, 2015); *A Way to Infinity* (maths, 2016), *Minnesota in the Cosmos* (geology, 2019); and *Living Worlds* (2021).

Beyond the sciences, astronomy frames the live-presented UK mobile planetarium show *Caesars' Stars*.

Fulldome Studio DN; Legends of the Starry Realm (2023)

In this show, experienced history (and astronomy) educator **Chris Hudson** examines Roman history and geography with audiences aged 7-14 years, linking to local sites within the context of Empire and encouraging the audience to howl like wolves.

Films using astronomy to frame cultural/religious topics include *Stories in the Stars* (indigenous Australian culture, 2013); *Deen al Qayima* (Islamic instruction, 2015), and *Legends of the Starry Realm* (Greek mythology, 2023).

3. Astronomy is not a significant aspect of the activity, which is focused on other disciplines

This category of shows is my main focus of interest. Such programs demonstrate planetariums' ability to fully embrace other disciplines on their own terms, transcending their beginnings as purely astronomical tools.

Physics / Computer Science

Thinktank Planetarium (UK) offers a short, live presentation called *Exploring the Atom* which uses fulldome clips.

The film *Making Magic* (2021) is about the development and creation of visual effects for games and film. This context is used to discuss how computers function, and the real-world physics that is required to simulate realistic scenes.

Earth Science

This is perhaps the most common non-astronomy discipline taught by planetariums. Earth-observation data is available through many planetarium software solutions, allowing easy creation of visuals for live presentations focused entirely on the Earth.

Some planetariums are even based in institutions with Earth Science focus:

Science Dome UK (UK) is a small geology-centred science centre with on-site mobile planetarium. They visualise NOAA Earth-observation data and their own 3D dinosaur virtual models within live-presented planetarium shows for schools and public, on themes including geology, oceanography, climate change, and dinosaurs.

The Museum of the Rockies (Montana, USA) is a geology/history museum. They created a short film (2013) for ages 11-18 years using specially created 3D visualisations of local watershed management concepts, narrated by researchers from the local university.

Dynamic Earth (UK) is a science centre communicating Earth-Science themes. In their live-presented show *Don't Panic* (natural hazards/climate change, 2023), they display some Earth datasets in 'inside-out' mode, so that one hemisphere of the planet can be seen across the dome at any one time.

At university level, **Fiske Planetarium** (Colorado, USA) is used for teaching geology and geography to undergraduate students.

The Fulldome Database contains over 30 films tagged as "Earth Science" which are unsupported by a clear astronomical context. These include *Force Five* (weather, 2010); *Atlas of a Changing Earth*

(climate change, 2021); *A Place Like No Other* (Arctic environment, 2022).

Chemistry

The fulldome film *Molecularium* (2005) gives a wacky introduction to atoms and molecules for children, teaching about properties of solids, liquids, and gases. The fulldome films *Sky on Fire: Fireworks in Fulldome* (2017) and *Hanabirium* (2019) present the history, development, and chemistry of fireworks.

Voyage Inside the Brain; Explorer Dome (2022-)

Human Biology

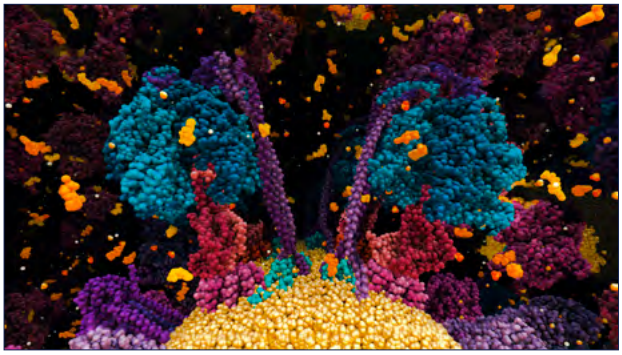
Planetarium fulldome software increasingly offers human physiology models including skeleton and major organs as standard. Similarly to astronomy, biology topics often require the learner to comprehend large scale differences. By zooming in, specialist models or film sequences can miniaturise audiences to fly them through blood vessels and inside individual cells, visualising features down to the atomic scale.

The Barlow Planetarium (Wisconsin, USA) has been running the live-presented show "Journey into the Living Cell" for 11–14-year-old school audiences since 1998. **Explorer Dome** (UK mobile planetarium, since 1998) offers three, live-presented biology shows to schools on cells, digestion, and neuroscience, and **Thinktank Planetarium** (UK) have live presentations comparing animal and plant cells[6].

Since 2022, **Lawrence Hall of Science** (California, USA) has been incorporating special live dome presentations into a wider programme for school ages 11-13 years; *Exploring Biotechnnology* explores Sickle Cell Disease and efforts to cure it using CRISPr technology. Students are encouraged to share observations about the visuals out loud, and to discuss how they might approach treating the illness observed.

"The planetarium is the only environment I know where students can truly observe all the key players in biotech, from changes to atomic scale DNA and proteins to the impacts on the larger worlds of cells, whole organisms, and even ecosystems–all while having discussions and sharing ideas." - Lee Bishop, Lawrence Hall of Science, California USA.

Examples of human-biology fulldome films for younger learners include *Cell! Cell! Cell!* (2012) and *Amigos! Inside the Human Body* (2014). And the recently released fulldome film *Chemistry of Life* (2023) accurately visualises cells in beautiful detail, showing the structure and motion of individual molecules.



Chemistry of Life (2023) Image credit: Visualiseringscenter C.

Nature

The planetarium also offers opportunities to visualise entire ecosystems, exploring how organisms are interconnected and dependent upon each other and their environments.

Underwater scenes are a natural fit for the planetarium. **Calusa Nature Center & Planetarium** (Florida, USA) was running their pre-recorded slide-based show *Manatee Encounters* in its (optomechanical) dome back in 2007, likely developed from a live-presented version. The stunningly realised fulldome film *Expedition Reef* (2018) explores underwater ecosystems and how environmental management projects are trying to protect them, while *Legend of the Enchanted Reef* (2021) offers young children an entry into similar themes of ecosystems and environmental change.

The fulldome film *Natural Selection* (2010) follows Darwin on his voyages, transporting audiences to diverse locations including his home, a coral reef, and mountain top. Other films on biology themes include *The Life of Trees* (2012), *Dinosaurs at Dusk* (2014) and *Habitat Earth* (ecosystems, 2015).

Engineering / History of Engineering

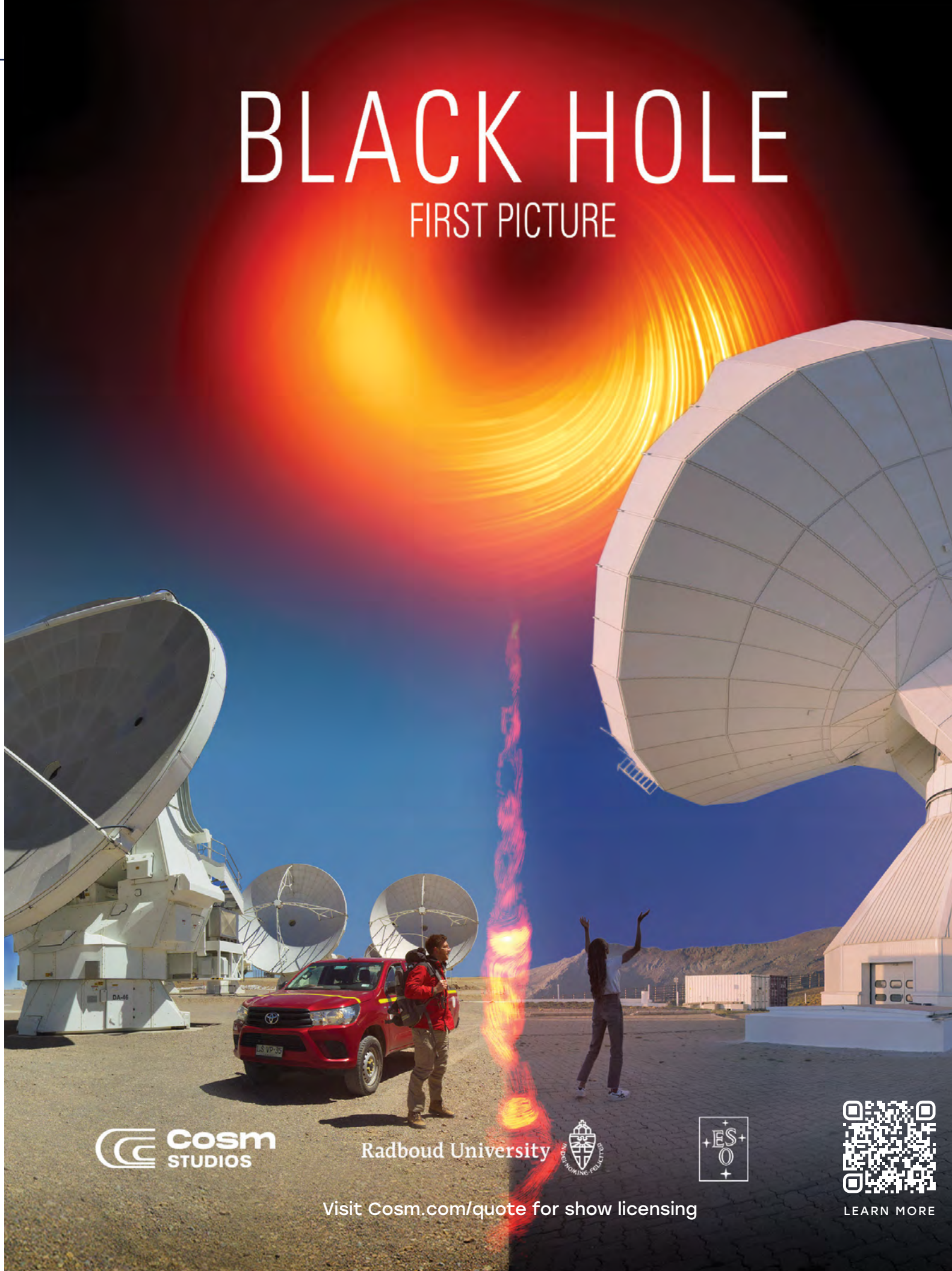
Explorer Dome (UK) collaborated with a local university to develop the live-presented mobile planetarium show, *We Make Our Future*, which is focused entirely on engineering. This highly interactive show includes historical contextualisation, fulldome gaming, and a challenge to find engineering solutions to help tackle climate change.

Fulldome films on engineering themes include *Dream to Fly* (2013), *Take Flight* (2015), and for younger audiences, the entertaining *3-2-1 Liftoff!* (2022).

Beyond the Sciences

History of astronomy is a topic that finds its way into many shows, with some fulldome films fully committed to this subject. For example, *Ancient Skies* (2013) is a documentary about how neolithic sites in the UK and Ireland provide evidence for the cultural importance of early astronomical knowledge. And *Moonshot: The Rocket Pioneers* (2022) tells the story of the pioneers who worked to make rockets a reality. History programs on other topics include the war history films *The Trench* (WWI, 2014) and *World 2 War* (WWII, 2016).

Educational cultural tours include *Carriberrie* (2018), a guided journey through traditional ceremonial dance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Carriberrie (2018) Image credit: Melbourne Planetarium.

and song in indigenous Australian communities. The experimental fulldome documentary *Lands of the Americas* (2021) journeys through the works of artist René Derouin, immersing audiences in the landscapes that have inspired his work. And on the Isle of Man (in the British Isles), a series of informative, live-action shorts about the island's history have been created by local producers, The Dome (2018-2023).

The dome can also be used for learning about the fulldome medium itself. While at **Fiske Planetarium** (Colorado, USA), undergraduate digital media students are assigned to produce fulldome photography and timelapse footage as a class assignment. This activity has been repeated every semester since 2017, excluding disruptions due to Covid. In 2022, students from their Media Studies program visited the planetarium to learn about the history of film from rectilinear to fulldome formats.

"The potential of this technology to bring people out of themselves and into full immersion in any physical surround, regardless of their own physical abilities, may be the best thing about this "new" era of the planetarium. From exploring within single cells to touring the Universe, anywhere, anywhen, we can experience these things all together." - Heather Preston, Calusa Nature Center & Planetarium

And perhaps my most unusual example of all: the **United States Air Force Academy** (Colorado, USA)'s planetarium was at one time used exclusively for flight training. This use pleasingly recalls how planetariums have been used throughout history for teaching stellar navigational skills, including to the Apollo astronauts.

Final comments

It is clear that this is not an exhaustive list; there are many other non-astronomy programs being run in domes around the world. However, I hope this article evidences the potential of planetaria for reaching beyond astronomy into other disciplines, and shows that these activities are not new, nor rare.

As fulldome visualization continues to decrease in cost, I look forward to seeing many more non-astronomy, live-presented shows and fulldome films that use exciting and informative fulldome visuals to immerse us in new and captivating ways.

Notes on research carried out for this article:

To add to the examples of which I was already aware, I solicited suggestions from the IPS Education Committee, the Dome-L and British Association of Planetaria email lists, and from personal contacts. The personal communications cited in this article are email responses to these requests; thanks to everybody who contributed examples.

Most of the fulldome films mentioned in this article can be found in the Fulldome Database at https://www.fddb.org/fulldome-shows/.

Report on Italy (con't.)

was immediately drawn to visit it. This planetarium is actually a museum centered around an 18th-century mechanical orrery designed by an amateur astronomer and built into the ceiling and attic above his former living room.

Why did he do it? Panic had ensued when fellow villagers believed an upcoming planetary alignment would somehow cause the Earth to perish. So, Eise Eisinga set out to create a model that would clearly and accurately demonstrate how the solar system operates. He undertook this incredibly difficult and complex task to educate and broaden perspectives. After I'd just spent time with Italian students trying to do much the same thing with my human orrery, I thought this would be the perfect place to reflect on the value and legacy of astronomy education, and the drive to share this cosmic viewpoint. Whether in Italy or elsewhere, my goal as an educator is to teach in a way that engages. I'm deeply gratified when I look into the eyes of students and see active thought and curiosity, especially when followed up by deep questions.

I am incredibly grateful for the opportunity to take part in the Experience in Italy program, made possible by the collective talents and collaborative work of Loris Ramponi and many other wonderful people. Before leaving my job, my next dream was to use this program as a model for creating a similar one bringing Latin American educators to California. This vision may morph into something similar or something altogether new.

As I write this, I am in a liminal, or in-between space, waiting to walk through the next door, yet unopened. I'm keeping in contact with Loris, a person overflowing with both ideas and the ability to see them to fruition. We have plans for further collaboration and my "*Experience In Italy*" will inspire me to pursue collaborations closer to home as well. I learned from my Italian colleagues, and I will continue on that path. In this manner, at least, the way forward is clear. We can learn so much from each other.

In spare moments throughout my time in Italy, I would check in with myself about how I was feeling. This is what came to me repeatedly: "il mio cuore è pieno." Translation: "My heart is full." And it still is.

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PLANETARIUM EDUCATION

100 Tips for Teaching in a Planetarium: First installment of a six-part series

Compiled and created by Ken Brandt, Co-Chair, IPS Education Committee

"Reach me down my Tycho Brahe..." begins Sarah Williams' poem, *The Old Astronomer to His Pupil*, in which the astronomer imparts some deathbed advice to his pupil, as time is short, and "Venus looks like ruddy Mars." We will all probably find ourselves in the old astronomer's boots someday, though perhaps less dramatically. Do you have wisdom that you want your students, staff, or mentees to have, even if they remember nothing else?

In this series, my colleagues and I are presenting some ideas for a list of 100 of the best practices for teaching in the dome, in concert with, and supporting, the centennial of the planetarium. This edition features the first 17 tips that concern *Setup and First Pitch*: advice for handling the setup and beginning of your program.

Develop an "opening routine" checklist. Describe what you do as you open the planetarium at the beginning of the day. Do your best not to omit steps that seem mundane, such as booting up all relevant devices or turning on the exit lighting, if applicable.

Have an outline, or a script, of what you do and when in the sequence each step should happen. Even if it's not written, knowing what you do in what order is essential if you want to...

Have objectives for the program you are presenting. If it is primarily an educational program, for example, what concepts and main ideas do you want the audience to understand? What relevant teaching standards are they, or should they, be aligned to?

If the program involves props or special equipment, be sure to have those available and powered up, and have spare bulbs, etc. at your immediate disposal.

Orient your audience to the room, especially for young children, and explain what will happen in the dome.

Ridky's *The Mystique of the Planetarium* suggests that we should familiarize the audience with the layout and function of the special equipment in the room, as fascination with it can impede learning under the dome. This especially applies to a big, beautiful, and complicated optomechanical projector (the elephant) in the middle of the room.

The planetarium is an exciting, novel experience for many young learners. Explain how you would like them to behave - what looks like misbehavior might just be not understanding what behavior is expected of them.

Establish the non-negotiables of behavior expectations, from not leaving and returning mid-program, to proper question procedure. It's important to keep your list of rules very short, so the announcing of them doesn't "glaze over" your audience.

Welcome your visitors at the door so that they can associate a face and real person with your "voice in the dark."

Start with the familiar. A good example is to start with the object(s) in the daytime sky.

From Jim Sweitzer: "It's the stars..." Remember that "...as astronomy educators we continually try to convey new ideas and topics with an ever-changing menu of shows, but we sometimes forget about this obvious invitation to experience the awe of a beautiful night sky."

From Shanil Virani: "Tell a story. Whatever the content of your star talk, make sure it has a beginning, middle, and end that follows a story arc.

Also from Shanil: Think about the main 3-4 ideas you would like your audience to leave remembering. Storytelling is a fantastic way to engage and inspire an audience to think."

Robert Fulghums' maxim, "Be aware of wonder." Remember that advanced (planetarium) visuals and other sensory inputs in the planetarium are indistinguishable from magic to your audiences. Use that to your advantage!

From Terry Pratchett: "It doesn't stop being magic just because you know how it works."

If there's one thing you want the audience to remember later, emphasize that thing as often as you're able. For example, Ken Brandt usually has at least two "overview effect" images in his programs. By having the image appear more than once, he emphasizes Earth's specialness and uniqueness slightly differently each opportunity.

Always keep the end in mind. Are all exit pathways clear and properly illuminated? Does the placement of props, projectors, or wheelchairs impede emergency exit flow?

Perhaps most important of all, do you know what to do in an emergency situation? Make certain that you understand emergency procedures, and to the extent possible, practice these often. In the worst-case scenario, your calm and confident handling of the situation can make all the difference.

In the next issue of the *Planetarian*, we delve into gaining audience knowledge and checking for understanding. If you have a tip that you think is appropriate for this section, please add it directly to this spreadsheet on google docs: *https://docs.google.com/spreadsheets/d/1rqE-Qocuy_pG66cGB4Ihmx4W67bzFikVv_DQyUIdw1A/edit?usp=sharing* .

Calling all interested planetariums: *Planetariums for Peace*

I came up with the idea for *Planetariums for Peace* because of my reaction to the horrible events caused by gun violence in the spring of 2022. The overwhelming despair and grief felt by those affected directly or indirectly by the events in Buffalo, NY, Uvalde, TX and so many other places couldn't be left unaddressed, I felt.

So, what could we planetarians do? I put out some feelers, and we put our heads together and decided to organize a "teach-in" for kids and adults in these communities and across the world. We are planning at least one virtual session,

an evening livestreaming extravaganza featuring as many planetaria as we can get for a live simulcast across domes! So far, the Robeson, Williamsville, Morrison, Hayden, and Adler Planetariums are working on this project. We hope to deliver the following message, each in our own way, "There is a larger perspective we should be working toward: love and kindness as part of a much greater 'tribe'"-an extension of Sagan's *Pale Blue Dot*.

We have many ideas percolating with this project. Do we seek outside funding for some of the resources we'll expend? Should we set up a non-profit? And more questions we haven't thought of yet.

We are looking for more institutions willing to host a segment of a larger planetarium production to be livestreamed, or to show the program to their audiences.

All proceeds from these telecons would be either donated into a non-profit foundation we set up, or a non-profit on the front lines of gun violence reduction like a gun buy-back program. If this program assumes an international aspect outside the USA, we can donate to another foundation or nonprofit whose aims are world peace.

If you are interested in contributing your time and talent to this endeavor, please reach out to Ken Brandt, kenneth.brandt@robeson.k12.nc.us.

INTERNATIONAL PLANETARIUM'S CALENDAR

COMPILED BY: LORIS RAMPONI

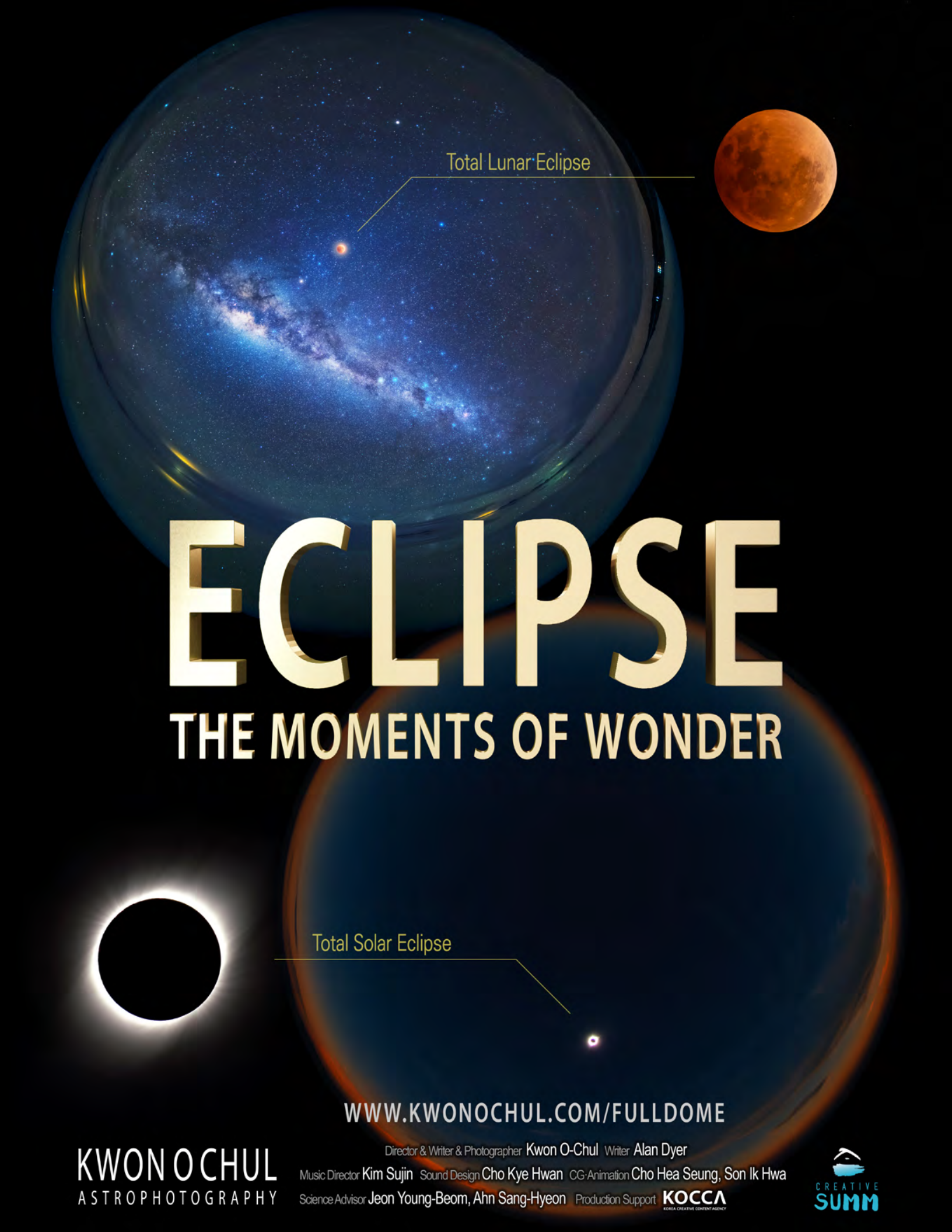
2023

- **8-10 September.** Nordic Planetarium Association, NPA Meeting,
  Tekniska museet, Stockholm, Sweden. The conference is open to anyone
  Contact: *mariana.back@tekniskamuseet.se*
  https://www.npa-planetarium.org/npa2023
  ...
- **12-14 September:** Live Interactive Planetarium Symposium,
  Michigan Science Center, Detroit, USA
  https://sites.google.com/view/lipsymposium/home
- **20-23 September.** Association of French Speaking Planetariums (APLF), Annual Conference, St. Michel l'Observatoire, France
  www.aplf-planetariums.org
  Contact: Milène Wendling, *milene.wendling@unistra.fr*
  ...
- **7-10 October.** Association of Science and Technologies Centers (ASTC), annual conference, Discovery Place, Charlotte, North Carolina, USA.
  ...
- **14 October.** Anular eclipse.
  https://eclipse.gsfc.nasa.gov/SEplot/SEplot2001/SE2023Oct14A.GIF
  https://eclipse.aas.org/eclipse-america-2023
  ...
- **21 October.** Anniversary activities for "Centennial of the Planetarium", grand opening parallel event in two locations, the Planetarium Jena and the Deutsches Museum in Munich, Germany. The event will be streamed and thus can be followed online. Guests who wish to attend in person in Jena or Munich (free of charge) are asked to register via the Centennial website.
  https://planetarium100.org
  ...
- **10-12 November.** LSS Workshop (of French mobile and small fixed planetariums), Planetarium of Mailly-le-Château, France.
  Contact: Lionel Ruiz, *lionel.ruiz live.fr; http://www.lss-planetariums.info/index.php*
  ...
- **13-16 November.** 14th Arab Conference on Space Sciences and Astronomy, Arab Union for Astronomy and Space Sciences in cooperation with the University of Sharjah and the Sharjah Academy for Space Sciences and Astronomy, Sharjah, United Arab Emirates. Tuesday 14 November is a special day for the planetarium field and its activities. The topics will include: State-of-the-art planetarium technologies; Fulldome shows; Planetariums in the Arab world; Planetarium related exhibition. The conference will be held in a hybrid format, in person, in Sharjah, and remotely through social media platforms.
  Contact: Arab Planetarium Society (APS), *aps2020.office@gmail.com*
  https://www.sharjah.ac.ae/en/Media/Conferences/AUASS-CONF23/Pages/default.aspx
  ...
- **31 December.** Deadline for the contest "A week in United States" For information and application requirements go to: *www.ips-planetarium.org/?page=WeekinUS*
  ...
- **31 December.** Deadline of the prize "Page of Stars" organized by IPS Portable Planetarium Committee in collaboration with Serafino Zani Astronomical Observatory.
  http://www.ips-planetarium.org/?page=pagesofstars
  Contact: Susan Reynolds Button, *sbuttonq2c@gmail.com*
  ...

2024

- **19-21 February.** Japan Planetarium Association(JPA), Annual Workshop, Cosmo Planetarium Shibuya,Tokyo, Japan.
  Contact: Misa Ichikawa, *ichimisa0518@yahoo.co.jp*
  https://planetarium.jp
  ...
- **31 March.** Deadline of PLANit Prize for an original video production, organized each year by Italian Association of Planetaria (PLANit), Italy. The prize is open to everyone. First prize is 500 euro.
  www.planetari.org
  Contact: *segreteria@planetari.org*
- **8 April.** Total Solar Eclipse (Mexico, USA, and Canada).
  https://eclipse.aas.org/eclipse-america-2024
  ...
- **April (date TBD).** Gesellschaft Deutschsprachiger Planetarien e.V., (GDP), Annual Conference of the Society of German-Speaking Planetaria.
  www.gdp-planetarium.org;
  Contact: *bjoern.voss@lwl.org*
  ...
- **April (date TBD).** Italian Association of Planetaria (PLANit), National Conference of Associazione dei Planetari Italiani.
  www.planetari.org
  Contact: *segreteria@planetari.org*
  ...
- **7 May.** International Day of Planetariums, 99th birthday of Centennial of the Planetarium
  https://planetarium100.org
  https://ips-planetarium.site-ym.com/?page=IDP
  ...
- **7 May.** Astronomy Day. Astronomy Day is a world-wide

(Continued on pg. 56)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Music Director Kim Sujin Sound Design Cho Kye Hwan CG·Animation Cho Hea Seung, Son Ik Hwa
Science Advisor Jeon Young-Beom, Ahn Sang-Hyeon Production Support KOCCA
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LAST LIGHT
CHATTING WITH FRIENDS

Bill Moser shared a thank-you note from a visit to his grandson's class:

> Dear Luke's Grandfather,
>
> Hi! Thank you so much for visiting my class even though I was not there but I bet it was so much fun. I heard you talked about light but thank you.

The Stars for All Conference in June, held at Bays Mountain Park and Planetarium near Kingsport, Tennessee and including all seven U.S. regionals, was a rousing success. Excellent and detailed planning kept things running smoothly. Great workshops and paper sessions, engaging speakers – even the field trips were super (except for the rain...)

The wolves exhibit at Bays Mountain was a favorite. Our group got to witness the wolves waking from an afternoon nap, with the alpha initiating a howling session. Howling (by humans) became a theme throughout the conference!

Karrie Bergland's mini LIPS conference before the main event featured sessions in asking and answering questions, particularly difficult questions. Discussions ranged from the serious to the lighter-hearted. "If you have a question, ask. If I know the answer, I'll let you know. If I don't, I'll pretend I didn't hear you."

Amy Barraclough and Connor Marti brought a large model of one of the wheels from Mars' Perseverance rover for their presentation. We were advised to handle the wheel by the edges, not the middle "because it could break, and we don't want to tell NASA it was you."

Oana Jones' timey-wimey "Relativistic Time Dilation for Toddlers" reported that the experiment involving twin astronauts Scott and Mike Kelly (one aboard the International Space Station and the other on the ground) worked out to a six minute and 13 milliseconds difference in their ages.

Paul Lewis described his small planetarium at the University of Tennessee: It has 32 seats and a subwoofer. It's actually in a large room with the dome hanging from the ceiling on one side. The Astronomy Lab meets in the rest of the room. So that's 49 seats total.

Jon Bell's theremin workshop featured two theremins, set up several meters apart ("very safe instrument from a COVID standpoint"), and participants were invited to try their hands (literally) at playing them. If you're unfamiliar with the instrument, check out a short description at *https://www.google.com/search?channel=fen&client=firefox-b-1-d&q=theramin#fpstate=ive&vld=cid:1450995f,vid:-QgTF8p-284* (the URL is longer than the video).

During his presentation, Jon turned the room lights down for a video, then moved away from the wall switch. The lights shot back up to full brightness. He tried again. Lights came back up full.

It seems that his room and one next to it were on the same light system, and the vocal class next door needed bright lights, so they changed them back with their wall switch every time. ("You know that triptych by Hieronymus Bosch? This is hell.")

Ken Wilson described his time as an intern at Rochester, New York's Strasenburgh Planetarium. Those of us who remember Don Hall as the director there know how clever he could be in show creation and might even remember the iconic "*The Universe Game*."

Strasenburgh used to produce public service announcements (PSAs) for their new shows. For "*The Universe Game*" opening, they decided that director, Don Hall, would be seated at a formal-looking desk in front of a green screen, and give a serious announcement about the show.

At the end of his announcement, some staff member would swoop in and dump a bucket of water over Don's head. Don chose Ken as the "dumper," mostly so there wouldn't be some staff member gloating about the stunt for the next three years, and instructed Ken to be sure to fill the bucket with warm water.

Of course, he used ice water...

Mike McConville's Armand Spitz Memoria Lecture (for the Great Lakes Planetarium Association) and Margaret Noble Address (for the Middle Atlantic Planetarium Society) combined the best of all that we do with seriously good ideas for all of us.

He described his days at Seminole College in Florida, where he and Derek Demeter dressed up as GPS satellites to guide people around campus during orientation. "We almost got arrested for being on a children's playground, which is what the planetarium community is all about."

"Shine a light in the dark; unless you're in a planetarium, in which case it's all right to be dark."

"Instead of standing on the shoulders (of giants, as in the Newton quote), BE the shoulders. It's not about seeing; it's about helping others to see."

He listed ten rules for leaving the planetarium world better than you found it:

10. Technology means nothing if you don't have a story to tell.

9. Community is the foundation of everything we do.

8. There is no such thing as a "career peak."

7. The times, they are a changin'.

("If I could just retire – a small dome, somewhere upstate. Ten kids, a few sheep, maybe some chickens in the dome...")

6. Take care of yourself, and take care of others, too.

5. You will impress someone, whether you know it or not.

4. Find a mentor. Be a mentor.

3. You are smarter and more capable than you can imagine.

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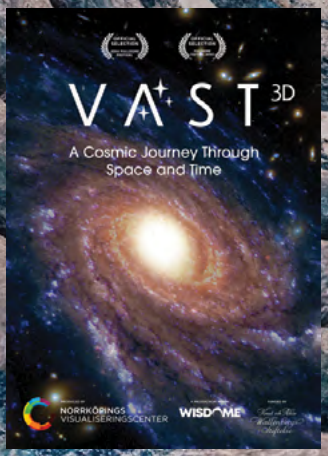

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The final gala banquet for the conference was held in Jonesborough, Tennessee, at the National Storytelling Festival site. Jennifer Monroe was our storyteller, keeping us spellbound with her family tales. The evening finished with Jennifer saying, "Any other questions? You ask really good questions. You must be intelligent people."

Patty Seaton: "And then you call on me."

Jennifer: "Everyone makes mistakes."

And to finish it off, the train whistle during her story was greeted with howls from the audience.

Disassemble Volumetric Models... (con't.)

radiation. Much of the nebula is very filamentary and is full of holes where more radiation can get through. Along these directions, the brightness of the gas is enhanced simply because more radiation from the central star reaches it, hence the radial spikes.

Figure 2 (bottom, left) shows only the bright, mysterious filamentary structure that is mostly imprinted on the shock wave expanding through the spiral shells. Much of the research on the Cat's Eye aims at explaining its complex and highly point-symmetric shape (Clairmont et al., 2022). While the details are quite tricky, one thing is clear: they are consistent with the central star not being single, but a binary. Point-symmetric structures are usually taken as a hallmark for a succession of events that happen at the same timescale as the orbital period of two objects that influence each other.

Putting it all together, the Cat's Eye Nebula is the result of a star coming to the end of its stellar evolution in close proximity to another star that helps shape the ejecta from the giant on its way to turning into a white dwarf. This story makes you wonder whether the pair will produce another glorious nebula once the second star begins to eject large amounts of gas and dust.

References:

Clairmont, R., et al., 2022, MNRAS, 516, 2, 2711–2717
Decin, L., et al., 2015, Astronomy and Astrophysics, 574, A5

Maercker M., et al., 2012, Nature, 490, pp. 232–234

Calendar (con't.)

event designed to celebrate all facets of astronomy.
https://www.astroleague.org/astronomyday/news

...

- **18 May.** International Museums Day, *http://icom.museum*

...

- **17-26 July.** International Planetarium Society Conference, Berlin-Jena, Germany.

...

- **17-21 July.** Pre-Conference Activities (Fulldome Festival, IMERSA Day, and LIPS Day).

...

- **21-25 July.** IPS Conference.

...

- **From 26 July.** Post-Conference Tours.
https://www.planetarium.berlin/ips2024
Contact:
ips2024@planetarium.berlin

...

2025

- 7 May 2025. International Day of Planetariums, 100th birthday of Centennial of the Planetarium
https://planetarium100.org
Ips-planetarium.site-ym.com/?page=IDP

Immersive Matters (con't.)

Emotions need to be involved for experiences to work, which means that engagement is more active than just simply watching. How we think and accrue new concepts is more physical than ever because of immersive spaces like fulldome.

Conclusion

In my experience, when there is something lacking in a planetarium project, it is all too often because someone in the work team did not understand the continuum of perception and thought. It may be a good idea to reexamine categorizations that are more fluid today, as useful as they were in the past.

Narrative, a stronghold of storytelling in dome experiences, relies on the ability to shift focus for a story to evolve. The focus on one aspect of a project does not exclude other aspects, and moreover, requires other aspects to stand together. There is no exclusive territory between learning and being interested within immersive environments. Ideally, there is engagement across a continuum no matter the aim. A sensory focused fulldome event may even have the merit of "leading us to" (educat) observe our own perception. This kind of work may be entering the human experience differently –but perhaps not that differently– from that of a scientific visualization fulldome event that "maintains" (inter+tenir) the connection of various realms to the reach of direct human existence.

We live inside many extended realities today. We are, perhaps, not engaged with the data that informs those realities. Extended realities require aesthetic navigation abilities in moving across scales and knowledge domains. To this end, the collaboration among disciplines, free of dichotomies, that partition the continuum of the human experience, is paramount.

Thanks to Carolyn Collins Petersen, Michael Daut, and Dan Neafus for their help on this column.

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Chiron III Hybrid brings majestic starry skies to two planetariums in Japan

Impressive realism at the Toyama Science Museum

The Toyama City Science Museum selected the cutting-edge GOTO Chiron III Hybrid to supplement their digital planetarium, last updated in 2009. The planetarium' s mission is to inspire fascination in the audience with the impressive realism of the images on the dome. The planetarium space is now open to the public with a much more realistic and beautiful starry sky to accompany the dynamic digital images.

Tadashi Hayashi, curator of the Toyama Prefectural Science Museum, said "CHIRONIII has made it possible to reproduce a beautiful starry sky that was difficult to visualize with a digital planetarium alone. We hope that many people will see it and deepen their interest in space. The dome theater provides a perfect place for enjoying detailed simulations. The museum has curators from various fields such as animals, plants, and insects, so I would like to use it as a place to explore multiple scientific topics in addition to astronomy."

In addition to the new equipment, the seating has been refreshed, including some new dual seats to increase visitor options. There is a large stage in front which can be used as a multi-purpose space or as a place to recline and be immersed in the stars .

One billion stars at "Dream 21" , Osaka

"Dream 21" , the Higashiosaka City Children's Culture and Sports Center, opened in 1991 as facility for children and has been loved by many citizens as a "children' s plaza for science, culture, and sports" . After 30 years of operation, it reopened on April 1, 2023 with a new hybrid planetarium that combines the GOTO Chiron III optical projector with Digistar 7 and two Sony GTZ380 projectors.

The new GOTO CHIRON III star projector that was delivered to Dream21 reproduces the Milky Way with 1 billion micro-stars, creating a more realistic, and beautiful, star filled sky. In addition, the Chiron III has a unique dimming function that allows control over the brilliance of stars that change depending on the season or weather, as well as the stars that begin to shine at twilight; all can now be reproduced more accurately and naturally than ever before.

The original seats have been replaced with wider reclining seats, and the theater' s interior has been re-envisioned as a space where you can experience nature. A special sheet, designed to look like you are lying on the lawn, is also attracting attention and is a feature that children love!

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