Special Focus: Preschoolers under the dome

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June: April 21
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December: October 21

Associate Editors
Book Reviews April S. Whitt
Calendar Loris Ramponi
Cartoons Alexandre Cerman, Chuck Rau
Data to Dome Mark SubbaRao
Classroom Education Jack Northrup
Education Committee Jeanne Bishop
Fulldome Matters Carolyn Collins Petersen
International Lars Petersen
Last Light April S. Whitt
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On the Cover:
The cover photo should look familiar. Others like it appeared in the June 2016 issue in Mobile News, about a new portable planetarium in Mexico. The space-togged kids were so cute that they were perfect for a focused look on preschoolers under the dome. Photo by Rene Gonzalez.

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Please notify the Editor and Secretary of any changes on these two pages.
Contact the Treasurer/Membership Chair for individual member address changes and general circulation and billing questions. Addresses also may be changed online on the IPS Web Site.
Note: I had a major case of writer’s block when it came to this issue’s column. What follows is stream-of-consciousness typing that might not be my best, but it’s from the heart and must be done to get Planetarian to press.—Sharon

Where did all these stories come from? There are so many different articles. I know I asked for submission for my focus on preschoolers under the dome and got a nice response (thanks Dayle, Wendy, Katy, Noreen, and Dayna.) And I’m devastated that I couldn’t fit Katie Blackman’s article in; that will have to wait until the March issue.

I knew that Ka Chun Yu, Dan Neafus, and Ryan Wyatt were preparing an article about the special needs of filmmaking for fulldome and they warned it would be long. No problem—it took a ton of work to research and write and I’m pleased that they not only did the work, but chose Planetarian to share it with the world.

Oh no! Another 100 page-issue! Maybe I should be careful what I wish for. I wish it was even longer, though. I wish I had stories about preschool education from Germany, and France, and Spain, and Italy, and Poland, and Japan, and Brazil, and Argentina, and Canada, and Africa, and. What can I do to convince planetarians in other countries to share their knowledge?

Especially after reading Tomáš Gráf’s summary of planetarian education in the Czech Republic and Slovakia—cannot everyone see that the problems and passion are the same around the globe?

Are there writers out there?

I wonder if I can find people to write stories for future issues. One would be about how to convince other disciplines to use our unique facilities. History teachers should love planetariums. Language teachers, too, especially now with a growing collection of astronomy snippets on the Voices from the Dome collection. (ips-planetariumsite-ym. com/?page=voicesintro) What about maths and other sciences? We can do it all!

I know I’ll have a story from Africa in the March issue. Joanne Young wrote about how connections have led to great results, and we’ll hear from Susan Murbana (I remember her from the IPS 2016 Conference in Warsaw; she was a stipend winner. She’s so full of energy!!)

I love making connections. One of the places I find them is through answering the “contact us” messages on the IPS website. Just love it when a plan comes together and I can connect a person with a question to the person with the answer!

And I so want every planetarium to make a connection with NASA/JPL’s Museum Alliance. They have tons of free material and also provide professional development. I don’t have the time (or the need, really) anymore to listen in on their professional trainings, but I so enjoyed them when I was working. I got to hear the information from the people on the front line of making space exploration happen, and even ask them questions. Wow.

It’s always so sad to put together the tributes section, this time especially. I regret that I never got to meet George Reed.

Years ago I put together a Christmas program for kids that I called *George and Oatmeal Save Santa*. I used a lot of George’s illustrations, which he made free to planetariums everywhere, but the others were a hodgepodge.

I thought I’d contact George and ask if he would be willing to draw some additional illustrations for the show. He said he’d think about it, and I sent the script to him.

About a month later I received a box in the mail, and in it were tons of new illustrations, just for George and Oatmeal! Ecstatic didn’t describe how I felt. He brought life to my little story of how George (a wizard, named for George Reed, of course) and Oatmeal (a snowman, a name stolen from my kids who had made a snowman together and named it Oatmeal) use the stars to find Santa, who is lost. They also tell Santa how to find his way home by using the North Star.

The image that I liked the best was the one of Santa flying off in his sleigh. George turned one of the reindeer into a snowdeer.

Maybe one of these days I’ll pull all my pieces together and, if I remember how(!), play with turning it into a fulldome program.

Hooray for Pedro Saizar! The astronomy center in Trelew in Patagonia has just waiting to be born, and he and friends made it possible. That was certainly a labor of love.

Should I admit that I was very late producing this issue? If I do, I suppose I’ll have to explain why, but I really hate talking about politics. Maybe I’ll do it anyway.

I spent a week mourning for my country after the presidential election here on November 8. I realize that not everyone shares my feelings and my fears for the future might be for naught.

To all planetarians across the world: you already know that all Americans are not like our soon-to-be president. We planetarians are kind, we share the love of science and knowledge, we care about people just the way they are. We all see the inner good in each other.

Knowing this helps me to cope. Thank you all for being there. ♡
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Connections

Has your life taken a direction that you had not planned on? If so, how did it happen? What connection did you make that was responsible for this journey you’re on? Please think about these questions just for a moment before you read on.

As IPS President, I have instituted a new Ad Hoc Committee called Emerging Communities, chaired by Dave Weinrich, past IPS president. He recently presented a paper at the October 2016 Great Lakes Planetarium Association (GLPA) Conference in Flint, Michigan, titled “Spreading the Gospel of Astronomy Across Africa.” He explained the definition of gospel is “good news,” and that is certainly the case for astronomy in Africa.

Why did I form the Ad Hoc committee? We have to go back many years and ask again my opening question: did I ever plan to be supporting astronomy in emerging communities? Not on your life!

But then I had not met Dale Smith, past IPS president, who invited me to Sri Lanka for a small IPS gathering in March 2001 to meet Sir Arthur C. Clarke, up close and personal. I came only for the opportunity to interview Sir Arthur. I hired a Sri Lankan television crew to tape the interview for posterity. It was a highlight of my life, a thrilling experience recorded on tape! I didn’t think anything could possibly top this Sri Lankan trip.

A surprise in Sri Lanka

During this small conference, I met a lot of wonderful international planetarians who also wanted to meet Sir Arthur. One even mortgaged her home for the travel funds. We knew we would be touring the Sri Lankan tropical countryside in a bus. We didn’t know we would be visiting schools and spending our nights into the early hours of the morning viewing the southern skies through telescopes with literally hundreds of children. This was not what we came for! This was our vacation!

To give you an example of our frustration, when we would arrive at a beautiful resort in what looked like paradise after a long day’s journey, we were directed to get on the bus again after a very quick dinner to view the skies and teach hundreds of children who did not speak English. You can imagine the complaints. I was the only IPS member who was not an educator or astronomer. As a result, I was paired with Francine Jackson, who helped me teach the multitude of children who were fascinated with the night sky. WOW! What an experience! I’ll never forget their excitement! It changed me forever.

It was in Sri Lanka that I met Dave Weinrich, who was yet to be IPS president. After that experience, we shared a common interest in providing this level of focus on astronomy for the children of emerging communities. Six years later, in 2007, Dave received a call from Jacob Ashong to help him build a planetarium in Ghana.

Connecting to Ghana

Most of you know the story, but for those who do not, Dave asked me to help. I enthusiastically agreed and called Jon Elvert, who was renovating his planetarium and had mothballed a Minolta Media-globe, owned by the City of Baton Rouge. I asked if he would donate it to Ghana. After a lot of time and effort convincing politicians and going through paperwork, Jon handed over his digital projector for the project. We picked it up in Baton Rouge and brought it to AVI in Orlando for maintenance.

Dave traveled from Minnesota to Florida to learn how to operate and maintain the system so he could personally train Jacob in Ghana. Dave also received many instructional programs, software, and shows from wonderful planetarians, both educators and vendors, who wanted to be a part of this great project. The generous spirit to contribute was encouraging and overwhelming.

After a great battle, we managed to get the planetarium to Ghana duty free. It was finally on its way to take center stage in the new domed structure Jacob built with his own retirement funds. That’s commitment!

Once the planetarium opened, Jacob invited interns to teach his children the wonders of the universe. Kyle Doane from the Perot Museum in Dallas, Texas, volunteered to spend a month teaching in the planetarium in Ghana, staying with Jane and Jacob in their apartment.

Kyle’s wife’s work with primates took him to Kenya, where he met Susan Murabana, who had been teaching science and astronomy to students in Nairobi. Dave introduced me to Kyle, and I learned that Kyle had been working with Susan to procure a portable planetarium for her work in Kenyan schools. As a result, Kyle asked his boss at the time, Rachel Thompson, to donate their Digitarium to Susan. She agreed and the Digitarium was returned to Digitalis Education Solutions, Inc. in Bremerton, Washington for maintenance before being shipped to Kenya. In order to ship the system, Kyle was tasked to raise thousands of dollars—which he did successfully.

And then on to Kenya

My work with widows and orphans in Machakos, Kenya meant I traveled often to Africa and I asked Kyle to introduce me to Susan. I was so accustomed to working with the very poor that when I met her, I was overcome by her beauty, elegance, eloquence, and passion.

(Continues on page 9)
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Dear IPS members, dear friends

I am now looking at two president awards sitting on my desk...my very own “two small pieces of glass.” This is a special honor, since I realize that I am the only one on this “pale blue dot” who has this privilege.

Dear friends, it was quite a ride, my time as an officer—from January 2011 till the end of 2016. This includes 2013-14, when I had the privilege of serving as your president a second time. And yes, it became a different ride compared to the years 1995-2000 surrounding the London conference in 1998, when I served as your president the first time.

It was at the IPS Conference in Alexandria in 2010 when I was asked and finally agreed to run a second time as president of IPS. I did it because I felt passionate about our international family and wanted to initiate change and restructuring of our organization.

Thanks to your support, I could initiate that process in 2013 known as the “Vision2020” initiative. I knew that this “vision” would mean a long-term strategy beyond my own term of presidency, but I did not expect to loose my comrade Paul Knappenberger, whom I had convinced to join me and to continue this vision. He surprisingly decided to resign as president elect in 2014, shortly before the Beijing Conference.

Vision 2020 on track

As a result we lost quite some time and momentum, but did make progress. On our roadmap towards 2020, the Vision 2020 team, officers, and your representatives on council are moving forward together, step-by-step, deciding about how IPS will be operating to benefit you much more in the future.

My sincere thanks to Joanne Young for stepping in for Paul as my follow-up and for her continued support of Vision 2020. Thank you also to my fellow officers: Lee Ann Hennig, Ann Bragg, and Shawn Laatsch, and also Dave Weinrich, who was part of this endeavor in the early phases. These marvelous people worked so hard and deserve your respect and continued support!

Thank you also to IPS council and to my dear friend Jon Elvert, chair of V2020, and his team and all the other committee chairs for tremendous efforts to move things further. Now I can leave the team of officers with a sense of pride about initiating and pushing forward V2020, but most importantly, I leave with confidence that this initiative is in good hands.

Creating a fulldome festival

Besides V2020, let me address two other achievements that I am especially proud of.

IPS fulldome festival: We managed to create an official IPS Fulldome Festival in 2014 at Macao Science Center and Beijing Planetarium in conjunction with the IPS conference. Thanks to the excellent support and work of Jiri Dusek and his great team at Brno Planetarium, we were able to continue this fulldome festival in conjunction with IPS 2016 right before the Warsaw Conference.

For the second time, the new IPS award for “Best Educational Production” was handed out in collaboration with Eugenides Foundation in Athens (saluts to Manos Kitsonas), this time at the IPS Conference in Warsaw. This focus of IPS on quality content for our domes and a festival attached to our biannual meetings will continue and be developed further for IPS 2018 in Toulouse, and IPS will also embrace the next Fulldome Festival Brno happening already in 2017.

Reviving IPS Committees: Several committees were restructured and quite successfully energized, like the IPS Education Committee (chaired by Jeanne Bishop).

The newly-inaugurated committees proved to be places where some of the key pathways and challenges for our future are explored and solutions discussed, especially Presenting Live Under the Dome and Immersive Audio.

The Science & Data Visualization Task Force, chaired by Mark SubbaRao, has opened many collaborations with scientists and major sources of digital data for domes, such as with the European Southern Observatory and other international research institutes, helping to make IPS and your work at your planetarium even more relevant as venues for presenting also the latest scientific projects and findings.

For quite some time I was encouraging the committee to organize its first Data 2 Dome Workshop, and I am happy that the workshop now seems to be coming together in early March 2017 at NAOJ, the world-class Tokyo facility of the National Astrophysical Observatory Japan. Other IPS workshops are being prepared also for 2017 by the Immersive Audio and by the Education committees.

My hope is these events in 2017 will lead the path to more opportunities for planetarians around the world to share, meet and train so they become more successful! In future non-conference years, IPS should be gearing up to arrange more such workshops and training camps on different continents, showcasing best practices and organizing “Think Tanks for the Future” and evaluating them.

How can we benefit members?

So, we should not just discuss membership fees, but stay focused first on determining the goals and benefits of membership for a truly diverse planetarium community, ranging from small one-person portable/school planetariums to large facilities both within or without a museum. There are different needs from these different planetariums and if we can target them specifically and handshake with the regional planetarium associations, we can offer what complements activities by regions for a global community, discussing and sharing best practices with the world. Thereby IPS could attract the minds and hearts of more planetarians so they want to become active members in our international organization.

We all know what is at stake and we need to join forces so that IPS...
President, continued from page 6

December 2016

Planetarian

9
Minutes of the 2016 IPS Council Meeting
Mars Room, Copernicus Conference Center
Copernicus Science Center
Warsaw, Poland
June 18-19, 2016

Also present:
IPS 2016 CONFERENCE HOST
Marc Moutin - Directeur des Expositions, Cité de l'espace, Toulouse France
Helene Boyer - Insight Outside-PCO for IPS 2018
IPS 2016 CONFERENCE HOSTS - WARSAW, POLAND
Dr. Robert Firmhofer- Director, Copernicus Science Center
Maciej Ligowski - IPS 2016 Warsaw Conference Host: Program Coordinator, Creative Planet
Monika Malinowska - IPS 2016 Warsaw Conference Host: Head of Conference & Events Management Dept. Copernicus Science Centre
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Nathalia Rippa Sierra, Planetarium of Bogota, Bogota, Columbia
Carolyn Sumners, Planetarium, Houston Museum of Natural History, Houston, Texas, USA
IPS VISION 2020 Planning Team
Jon Elvert, Chair
Facilitator-Liz Monroe-Cook
Karrie Berglund
Ruth Coalson
Marc Moutin
Mark Subbarao
Guests:
Sharon Shanks-Editor, IPS Planetarian
Susan Button

* indicates action items

In attendance:
President Joanne Young
Past President Thomas Kraupe
President Elect Shawn Laatsch
Treasurer Ann Bragg
Secretary Lee Ann Hennig

Affiliate Representatives:
Association of Dutch Speaking Planetariums (ADSP) - Jaap Vreeling
Association of French Speaking Planetariums (APLF) - Marc Moutin/Proxy Pierre Lacombe
Association of Mexican Planetariums (AMPAC) - Ignacio Castro Pinal/Proxy Shawn Laatsch
Australasian Planetarium Society (APS) - Shane Hengst/Proxy Martin George
British Association of Planetaria (BAP) - Mark Watson
Canadian Association of Science Centres (CASC) - Frank Florian
Chinese Planetarium Society (CPS) - Dr. Jin Zhu/Proxy Thomas Kraupe
European/Mediterranean Planetarium Association (EMPA) - Manos Kitonas
Great Lakes Planetarium Association (GLPA) - Mike Smail
Great Plains Planetarium Association (GPPA) - Jack Northrup
Italian Association of Planetaria (IAP) - Loris Ramponi/Proxy Simonetta Ercoli
Japan Planetarium Association (JPA) - Kaoru Kimura
Middle Atlantic Planetarium Society (MAPS) - Jerry Vinski/Proxy Patty Seaton
Nordic Planetarium Association (NPA) - Aase Roland Jacobsen
Pacific Planetarium Association (PPA) - Benjamin Mendelsohn
Rocky Mountain Planetarium Association (RMPA) - Michele Witsisen
Society of German Speaking Planetaria (GDPS) - Bjørn Voss
Southeastern Planetarium Association (SEPA) - John Hare
Southwestern Association of Planetariums (SWAP) - Rachel Thompson

Not Present:
Association of Brazilian Planetariums (ABP)
Association of Spanish Planetariums (APLE)
Russian Planetarium Association (RPA)

Audit Report of 2015 confirmed that the treasury is in good standing and the document has been posted on the Council Group Site. The Treasurer's Report was filed.

As Membership Chair, Ann Bragg reported that the total membership as of May 2016 (516) will be updated to reflect conference attendance. The Membership Report was filed.

Past President Thomas Kraupe and President Joanne Young gave their officers' reports. They will be published in a forthcoming issue of Planetarian. The Past President's and President's Reports were filed.

President Elect Shawn Laatsch announced that the 2017 IPS Council Meeting would be held in St. Louis on October, 2017, more details will be forthcoming.

Affiliate Reports
Affiliate Representatives introduced themselves. Two new representatives were welcomed: Frank Florian, representing the Canadian Association of Science Centres (CASC), and Mike Smail, representing the Great Lakes Planetarium Association (GLPA).

Nordic Planetarium Association (NPA) Representative Aase Roland Jacobsen gave a special report on how a group of young people collaborated with NPA to set up a Facebook page for the NPA.

Concern was expressed about the lack of participation and communication from several affiliates and that the officers will monitor the situation.

The Affiliates Reports were filed (they are available on the IPS Website).

Affiliate Reports not submitted: Association of Brazilian Planetariums (ABP), Association of Spanish Planetariums (APLE)

Conferences
IPS 2016 Conference
President Joanne Young introduced our conference hosts Maciej Ligowski and Monika Malinowska, who welcomed us to their wonderful facility and presented an overview of the conference.

IPS 2018 Conference
Marc Moutin, director of expositions, Cité de l'espace, IPS 2018 Conference host, presented preliminary plans for the conference in...
President Joanne Young reported that Mark Nursall, President and CEO, Telus World of Science, for Edmonton Alberta, Canada

Nathalia Rippa Sierra, for the Planetarium of Bogota, Bogota, Columbia

Carolyn Sumners, Planetarium, Houston Museum of Natural History, Houston, Texas, United States

Questions and discussion from Council to the presenters helped to clarify the proposals. President Joanne Young thanked the presenters and Council voted to accept all three bids. The final vote on the winning bid will take place at next year’s Council meeting. The bidders will present their bids to the membership at the business meeting later in the week and there will also be articles prepared for the membership to be published in Planetary.

Standing Committee Reports

In keeping with the compressed format of the Council meeting, Standing Committee Reports were previously submitted and reviewed by Council. The full committee reports should be posted on the individual Committee Webpages and the Council Webpage. Discussion from the floor centered on selected committees:

Awards Committee

Awards Committee Chair Manos Kitsonas presented the IPS Awards Committee Report. The President’s Award (Thomas Kraupe), the IPS Fellows (Patty Seaton, Christian Thies, Kai Santavuori, and Mark Trotter), and the Technology and Innovation Award (Carter Emmart) honorees will be presented at the awards luncheon to the membership. There were no nominees for the IPS Service Award.

The Chair outlined a proposal to award IPS Honorary/Commemorative medals. A silver medal as a “Thank You” at conferences (recipients to be decided on by Officers). Gold medals would be given to individuals or institutions who have had an impact on the planetarium field (nominated by members and approved by Council). The Medals should be accompanied by a written certificate with formalized wording. Manos will finalize a draft of the award design and criteria, present it to Council for consideration, and it will be voted on via e-mail. The first medals will be presented next year.

*Thomas Kraupe moved to approve the concept of the Silver and Gold Medal awards, seconded by Patty Seaton and approved by Council.

The Committee will continue to review alternate award designs and categories of awards explore guidelines and criteria for awards.

Elections Committee

Elections Committee Chair Martin George announced the slate of nominees for officers:

President Elect
- Jack Dunn, retired planetarian, South Carolina, United States
- Levent Gurdemir, University of Texas at Arlington Planetarium, Texas, United States
- Lee Ann Hennig, Thomas Jefferson High School Planetarium, Virginia, United States
- Mark SubbaRao, Adler Planetarium, Illinois, United States (*nominated at Business Meeting from the floor)

Secretary
- Patty Seaton, Howard B. Owens Science Centre and Planetarium, Maryland, United States
- Rachel Thompson, Perot Museum of Nature and Science, Texas, United States

Treasurer
- Ann Bragg, Anderson Hancock Planetarium, Marietta College, Ohio, United States
- Martin will announce the slate at the General Business Meeting, at which time additional nominations will be entertained from the floor and the candidates will give brief statements. The election process will be conducted as usual this fall.

Publications Committee

President Joanne Young gave an update for IPS Publications Committee Chair Dale Smith on the IPS Directory. They are making progress on transitioning to an on-line version and expect to have it ready soon. Past President Thomas Kraupe requested that details on search criteria in the on-line version be detailed so we know what will be available. This was a part of the project put forward by Council at the Beijing Conference. *Joanne will follow up with Dale.

Standing Committee Reports were filed.

Ad Hoc Committee Reports

Ad Hoc Committee Reports were presented, reviewed and discussed. Complete reports will be posted on the IPS Web Site Committee Pages. Other news from the floor:

Historian John Hare reported that IPS History Committee would like to have a designated “affiliate historian” who would be passing on information to the committee to compile data.

President Joanne Young reported that Mark Webb (Adler Planetarium) was no longer chair of the IPS Presenting Live Under the Dome Committee and that Derek Demeter (Seminole State College of Florida) would be taking on the duties.

Chair Susan Button of the IPS Portable Planetarium Committee reminded Council that if the name of the Affiliate portable planetarium contact was left blank on the Affiliate Report form, then she would use the Affiliate Representative name as the contact. It is preferable to have someone in the portable field as the representative.

Jon Elvert reported that the IPS Website would be updated on the Vision 2020 Initiative on where the project stands, new documents that have been released, and future steps to be taken. The Ad Hoc Committee Reports were filed.

Constitution Matters

Secretary Lee Ann Hennig reported that changes to the By-laws and Standing Rules were being considered in view of Vision 2020, specifically revisions/updates in appendices and general consistency and clarification edits to keep the document current. Particularly, the rules should be documented for stipends or scholarships. *Secretary Lee Ann Hennig suggested that the Officers and International Relations Chair Martin George draft a proposal on how to incorporate the stipends into the Conference Guidelines and work with Vision 2020 on the overall structural constitutional revisions. Past President Thomas Kraupe added that strategies involving new members and professional development should also be included.

Unfinished Business

EMPA Representative Manos Kitsonas expressed concern about affiliates at risk. Discussion centered on those geographic areas that are at risk and the issues they are facing. *The Officers will follow up on the affiliates at risk and report to Council.

New Business

Portable Planetarium Committee Chair Susan Button presented a proposal to try to expand the “international” aspect of IPS by promoting a cultural exchange program in the United States. Discussion on the proposal ensued, and Susan asked that IPS start with 2 recipients funded at $1000/year for two years and a complementary IPS membership. Susan wants to see where the initiative will go. It is imperative that the Affiliates encourage their members to apply. There was additional discussion about support for workshops and other opportunities. *Motion moved to approve the initiative as a model for two years, seconded, and unanimously approved. The committee will come up with the details of the proposal and send them to Council for approval.

(Continues on next page)
that could be linked to the IPS website. So moved by Mike Small, seconded by Shawn Laatsch and approved by Council.

Science and Data Visualization Committee Chair Mark SubbaRao’s report was presented by Thomas Kraupe. The committee would like to propose partial funding for a Data to Dome workshop in Tokyo, the results of which would be shared with the IPS community. PPA Representative Benjamin Mendelsohn said that we need to see a more detailed proposal. *It was proposed that a draft be sent to Council specifying the benefits and the expenses of the proposal and to consider it as an email vote.

Set your sights on a free fulldome program

SEEING, a fulldome program that follows a photon’s creation and journey across the galaxy to a young stargazer’s eye, is now available free of charge to planetariums everywhere.

It was produced as a companion to Sight: The Story of Vision, a one-hour documentary produced for the Public Broadcasting Service that explores how our vision works and how the brain translates what we see into images. “The story’s threads will weave the tale of the journey of humanity that discovered the science; technology and medicine that allows us to understand how sight works, cure diseases of the eye and correct vision,” according to the film’s website (www.storyofsight.com).

The 22-minute fulldome program is available by registering and downloading at: www.StoryofSight.com/IPS/Zeiss Seeing. It includes the 4K dome master files, audio files, a PDF copy of the script, and an education guide.

The program follows the photon into a girl’s eye, learning the structures of the eye and their functions, prior to taking a ride on the optic nerve.

Dramatic fulldome imagery from around the globe featuring humanity, landscapes, skyscapes, wildlife, and space are used to create the story of the journey through the eye and its conversion to the electro-chemical impulse traveling the neuro pathways of the brain to create the image we see. Along the way the program examines how the eye works and how technology has enabled us to restore vision and prevent a variety of diseases that affect sight.

Produced by Mirage3D and Koenig Films and funded through a generous grant by Zeiss, this program takes the story of sight and vision to planetariums around the globe. SEEING was directed by Robin Sip, written by Emmy Award-winning writer Kris Koenig, and narrated by Dr. Neil deGrasse Tyson, director of the Hayden Planetarium at the Rose Center for Earth and Space in New York City.

The program is produced in English, but planetariums may translate the program into other languages as long as they share the recorded narration as a digital file and a word document of the translated script with the producers.

If you have any questions regarding acquiring this program or regarding language translations, please contact Shawn Laatsch at shawn.laatsch@gmail.com.

Thomas reported that IPS is now in partnership with Asteroid Day to support this worldwide public education effort about asteroids and the associated science and scientists working in the field.

Asteroid Day will be held each year on June 30, the anniversary of the largest collision with Earth in recent history, the 1908 Siberian Tunguska event. There is a fulldome video by ESA and there will be experts available for planetariums in this collaboration as well.

With business completed, Martin George moved to adjourn the meeting, seconded by Benjamin Mendelsohn, and approved by Council.

Respectfully submitted,

Lee Ann Hennig
Executive Secretary, IPS

Addendum to the Minutes

Day 2 of the Council Meeting, June 19, 2016. This session was devoted to the Vision 2020 Initiative and is detailed in Jon Elvert’s Report in the September 2016 Planetarian.

Wednesday, June 22, 2016—Closed Session 7:30-8:30 p.m.

A report will be submitted by the IPS Vision 2020 team documenting Council action taken during the meeting on June 19, 2016.

*Mike Small moved to approve payment of the second installment ($10,000) to Jon Elvert for the completion of his first 12-month consultant contract.

*Mike Small moved to approve payment of the first installment ($10,000) for Jon Elvert’s second 12-month consultant contract through the end of 2016, with another $10,000 to be paid upon completion, seconded by Patty Seaton and approved by Council.

*Shawn Laatsch moved to approve the top 4 goals of the Vision 2020 Initiative, seconded by Benjamin Mendelsohn and approved by Council:

1. To continue with simple changes in the Mission Statement.
2. Continue collaboration efforts with entities such as NASA, ESO, IAU, WWT, STScI, Kavli, IMERSA, LIPS, and others.
3. Complete the recommendations for member dues to include the sliding scales as discussed.
4. Regarding the web document (shared with Council prior to the meeting), Council wants to see recommendations as to what is best for IPS, taking into consideration our membership database and the recordkeeping functions our current provider already has. Council agrees the WordFess model is good. It was agreed that a new website is very important and should take a top priority.

*
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When we speak of Bogotá, we not only refer to the capital of Colombia, but also its most important city. Bogotá is a thriving, cosmopolitan, and diverse city, nestled 2600 meters high on the Andes Mountain Range.

The Planetarium of Bogotá is a hub for cultural activities and scientific dissemination of the District Institute of the Arts (IDARTES, for the Spanish original), an entity under the Secretariat of Culture, Recreation and Sports of the Office of the Mayor of Bogotá.

Its structure was designed by the Colombian firm of Pizano, Pradilla, Caro and Restrepo in the 1960s, and it has become one of the most emblematic and iconic symbols of the city, recognized as a place where ideas, innovation and entertainment are generated around scientific activities.

In 1969, during the space race, a magnificent shell-shaped building went up in the heart of the city: the Planetarium of Bogotá, the most important of its kind in Colombia. This planetarium has one of the largest domes in the Americas, measuring 23 meters in diameter. The Mark IV optical-mechanical stars projector, built by the German firm Carl Zeiss, is still in operation there.

In 2009, the Planetarium of Bogotá began a renovation process that culminated in 2013, featuring equipment with new and marvelous spaces dedicated to astronomy, including the innovative Space Museum, a children’s room, a multi-purpose area for workshops, an auditorium, and a lovely terrace with a 360° view above a beautiful urban park.

Three years after its re-inauguration, the Planetarium of Bogotá is one of the most frequented cultural spaces in Colombia, thanks to its design and ongoing offering of classes, workshops, astronomy clubs, celebration of astronomical ephemerides, special events, experiences, and temporary exhibits that have allowed us to reach more than 1,500,000 visitors and raise over USD 2 million, which has been reinvested in the creation of new plans, programs, and projects to disseminate astronomy and space science.

Nominating the Planetarium of Bogotá as the host of the 26th Biennial Conference of the International Planetarium Society (IPS), which will be held in 2020, is an endeavor by IDARTES with support not only from several planetariums around the country, but also from universities and entities at local and national levels. But it is also part of a strategy by the local administration, which has worked arduously with various sectors, to project the vision it wants for the city in 2020: Bogotá as an international icon, a city that is creative, inclusive, sustainable, and happy, where science and education are highly important.

In that regard, the Bogotá Mejor para Todos (Bogotá Better for Everyone) 2016-2020 Development Plan of the newly-elected mayor of Bogotá, incorporates the importance of “the quality of urban life that promotes development based on knowledge” as one of its fundamental pillars. With these tenets and in order to invest in specific issues, a project was created, called “integration between art, science, technology, and city.” The Planetarium of Bogotá is largely in charge of this project, which aims to promote and showcase the synergies between art, science, technology, and its connection with the city.

Thus, we believe that technologies, scientific culture, the arts, and the city will blend...
and evolve together. Technology will expand the creative limits of artistic and scientific practices, open new possibilities for access to marginalized populations, especially people with disabilities and in early childhood, and increase dissemination channels for artistic creations together with digital logic. This is so that technology can expand or qualify the creative scope of field agents while fully exercising their cultural rights (to know, practice and enjoy).

From this perspective, the question that the Planetarium of Bogotá wants to answer in IPS 2020 is: What is the planetarium's role when immersion technologies and augmented reality have reached the homes? If our public does not need to visit our planetariums to meaningful immersion experiences because they can do it from their homes with mobile devices or smartphones, what can we do to keep them coming?

The answer may be in three concepts:

Create: It is the opportunity to challenge ourselves to create new strategies and methodologies that capture the imagination, attention and ways of interacting with our public. We propose new dialogs with our visitors in which the Planetarium goes from being a setting for exhibits and information to a space in which the public is challenged to complete missions or projects that involve searching for information, problem-solving, and teamwork.

Re-Create: Re-create means to create again. In that regard, we propound planetariums as creators of culture, rescuing the identity of our people through the legends and cosmogonies of our indigenous groups. Using astronomy also as a tool to build peace through activities and workshops on the origin and size of the universe, distances and scales and others, it will be possible to engage in an exercise in humility and thereby identify and appreciate differences and begin a new path toward acceptance and forgiveness that will lead us to better coexistence.

Co-Create: Planetariums can become creation laboratories through the synergies of art, science, and technology, where the public can go from being mere spectators to co-creators of meaning, where networks are established that connect and integrate, and where contents are shared among user communities.

To co-create allows users to be part of the planetariums, to assume them as their own, and to work for them so that bonds are consolidated with our closest and most direct public, which allow us to create communities of actors-participants-creators.

With these topics, we propose to cover all items that are important for the planetary community, from construction, renovation, and administration; passing through the creation of content and methodologies; to bringing astronomy to the communities through dissemination, communication, public relations, and marketing. We also would like to build a tool that allows us to consult with the members of IPS, to create the agenda together, and be able to integrate the interests of the attendees.

On the agenda

On our agenda, we have planned time in the morning and afternoon hours for:

- General lectures or conferences with experts at the international level
- Workshops
- Parallel sessions
- Sessions for posters
- Team building, so that all attendees have time to get to know each other and share experiences and knowledge
- Show rooms for sponsors and space for demonstrations
- Dome Village

In the afternoon and at night, we will have:

- Welcome cocktail gathering
- Astronomy shows
- Art and science shows
- Open air concerts
- Gala dinner

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To hold the IPS 2020 meeting, we have Hotel Crown Tequendama as a partner of IDARTES and the Bogotá Planetarium. It is located less than 200 meters away from the planetarium and can offer more than 14 fully equipped rooms for events and conferences with a capacity from 10 to 5,200 people at the same time. The hotel also has 573 rooms, out of which 10 are designed to meet the requirements of disabled people, as well as 286 suites. There are more than 10 hotels of different categories in the vicinity with 800 rooms, just to mention some of the advantages for the people who visit the city.

To hold the 26th Conference IPS 2020, we have a team of over 150 volunteers who are math and physics students and graduates in education, math, and special education from the best universities in Bogotá, who will support the logistics and organization of the event. Also, the IDARTES and its Bogotá Planetarium will have a professional team of logistics personnel available to guests who will guarantee security and a pleasant development of the event.

All facilities, both at the Bogotá Planetarium and at the Hotel Crown Tequendama, have internet access, audiovisual equipment, and projectors.

**Registration costs**

The nomination of the IDARTES-Bogotá Planetarium to host the IPS 2020 Conference has the support of not only the Bogotá City Hall, but also national public entities, as well as the educational and tourism promotion sectors. This, in addition to other partnerships, will allow us to guarantee an initial registration cost of USD 600. We also will launch an aggressive campaign to receive donations and sponsorships that will ensure that we are able to offer a high quality, organized conference at reasonable costs to attendees.

**Bogotá’s connectivity**

The city is located 5 hours away from New York City on a direct flight or 5 hours away from Buenos Aires on a direct flight, making Bogotá an accessible destination for the 26th International Planetarium Society Conference 2020. There are more than 700 weekly international direct flights, direct connection to more than 43 countries, 32 airlines with flight to Bogotá, and a brand new airport: El Dorado International Airport, Colombia’s main connection center for domestic and international flights.

**Moving around Bogotá**

Transmilenio is a mass transit system with its own carriageways, which came into service in 2001. It uses two or three module “bendy-buses.” This system is an example not only of the improvement of the traffic system, but also a response to climate change. This model has been adopted by 12 other cities around the world.

Since 1998, Bogotá has built more than 340 kilometers of protected bike- ways. More than 90,000 people a day use this very high quality bicycle infrastructure. On Sundays, some of the avenues become recreational bike ride streets. Skaters, athletes, or simple walkers also use them. These ride bike streets are not only a model in South America, they have also become the most important focus of recreation and sporting amusement where more than a million people use them every weekend.

The Bogotá Planetarium is strategically located in the heart of Bogotá, a block away from Carrera Séptima, the main highway that runs from north of the city to the south; a block away from Calle 26, which runs from east to west; twenty steps from the Integrated Public Transport System bus stop; three blocks from the Museo Nacional Transmilenio station and all its amenities to take a taxi. For some activities that will be held at other buildings nearby, attendees can walk, or the IDARTES-Bogotá Planetarium will have shuttles available for safe transport.

Finally, we would like to express that IDARTES and the Bogotá Planetarium understand and accept the responsibilities of organizing the IPS 2020 Conference in accordance with the guidelines of the IPS. Therefore, we are confident that we would be the best hosts as we are a place where scientific culture, art and technology are perfectly combined to build identities, motivate and amaze all audiences.
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Alan Nursall, President and CEO
Frank Florian, Director, Planetarium and Space Sciences
Cathy Barton, Executive Assistant
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anursall@twose.ca, fflorian@twose.ca, cbarton@twose.ca

Alberta does lakes and mountains like Rome does cathedrals and chapels! In the heart of a province where you can visit hoodoos in the morning and icefields in the afternoon, you’ll find one of the most technologically advanced planetariums in the world. The home of this planetarium was also home to the first planetarium in Canada.

TELUS World of Science-Edmonton (TWOSE) will be honoured to host the IPS biennial conference in 2020. Our bid for this conference is fully supported by the Canadian Association of Science Centres, the City of Edmonton, the Royal Astronomical Society of Canada (Edmonton Centre), and the board and staff of the TWOSE. The bid is also supported by many other community partners.

Edmonton is the capital city of the western Canadian province of Alberta and is a city defined by all four seasons. The northern summer is an ideal time to visit. The days are warm and long, the weather is glorious, and there is an amazing range of things to do, see, and participate in, both within the conference setting and in the wider community. There’s even a chance to see the northern lights and noctilucent clouds! That is why the dates June 21 to 25 have been selected for the conference.

Edmonton is appropriately called The Festival City, hosting hundreds of cultural events like the Taste of Edmonton, the Edmonton International Street Performers Festival, and the Summer Solstice Music Festival, to name a few. It is no wonder that National Geographic magazine picked Edmonton as one of the top summer destinations in the world in 2015! Edmonton is also one of the most multicultural cities in the world, home to people representing just about every facet of human heritage one could imagine.

Edmonton’s population is just over a million people, big enough to boast all the cultural amenities of a great city but contained enough to be livable. It is a spacious city. Hard to believe, but the population density is about 110 people per square kilometre. By comparison, Shanghai is nearly 3,000 and Boston is about 4,700. There is lots of room to breathe in Edmonton.

Edmonton is the location of Canada’s first public planetarium, the Queen Elizabeth Planetarium (QEP). It opened its doors in September 1960. Its first director was Ian McLennan, who later became the director of the Strasenburgh Planetarium in Rochester, New York, and who today continues to consult on many planetarium and science centre projects around the world. The year 2020 will mark the 60th anniversary of the QEP and of the introduction of the planetarium experience to Canada. What a marvelous way to celebrate this milestone in planetarium history by hosting the IPS 2020 conference.

The QEP was the progenitor of our current facility. TWOSE is a major science education facility that now boasts the second largest attendance of any attraction in the entire province of Alberta¹ with more than 575,000 visitors a year. TWOSE occupies a large footprint of 10,800 m² (16,250 sq. ft.) and is located in Coronation Park. Major new wings will be added to the facility by 2019 and the historical Queen Elizabeth Planetarium, adjacent to the TWOSE park, will be fully renovated by 2018.

When it opened in 1984, TWOSE featured a large planetarium facility with a 23-m dome, huge projection gallery and cove, Zeiss projector on a silent elevator, 220 reclining and swiveling seats, and an impressive array of special effects. In 2008 the planetarium was modified into a Digital Visualization Theatre featuring the Sky-Skan Definiti 2 system.

By 2018, the planetarium will have undergone a complete redevelopment that will

¹ The Calgary Zoo ranks first.
create one of the most technologically advanced dome theatres in Canada. The rejuvenation of the theatre includes a new Astro-Tec Ultra-Seam dome, new theatre seating, a 10K digital projection system using 12 Sony VPL-GTZ270 projectors, a new sound system, theatre lighting, and Dark Matter/Digital Sky software from Sky-Skan.

Our facility operates, in conjunction with the Royal Astronomical Society of Canada (Edmonton Centre), a first-rate public observatory adjacent to our main building. This observatory is home to many different telescopes, including a Planewave 17" telescope on a Software Bisque Paramount German equatorial mount, a Meade 16" LX200 telescope, a superb AstroPhysics 7" refractor on a Losmandy mount, and a Lunt solar telescope, to name a few. Our observatory will be open during the conference.

In addition to the many science galleries and exhibits, TWOSE also boasts a state-of-the-art 3D digital laser flat screen IMAX® theatre.

Facilities

The Shaw Conference Centre is nestled on the banks of the North Saskatchewan River, providing a fabulous view of the majestic river valley with its many biking and walking trails. With its 13,950 m² (150,000 sq. ft.) convention, exhibition and meeting space, this venue has plenty of room to accommodate all of the elements of the conference. Many of the sessions and activities will be held at this location. The facility is just a few steps away from the chosen conference hotels and by our light rail system for those interested in staying at other locations.

TWOSE will be the venue for in-dome sessions, professional show and tell, and vendor demonstrations. Together, these two venues can accommodate the entire IPS conference with parallel program sessions during the day. The Queen Elizabeth Planetarium can be used for smaller breakout sessions during the day.

There are also elegant meeting and accommodation facilities at the University of Alberta, complete with a rooftop observatory and a fabulous meteorite collection, the second largest of its kind in Canada. The architecturally stunning Edmonton City Hall, the attractive Art Gallery of Alberta, and the new Royal Alberta Museum will provide plenty of other opportunities in the downtown core for special sessions and receptions.

Facilities like the Edmonton Symphony, Art Gallery of Alberta, and Royal Alberta Museum will have special pricing on their programs and exhibits at the time of the conference, which may be of interest to the delegates. The Edmonton International Airport is an ultra-modern high-tech facility designed with traveler convenience, safety, and comfort in mind. It is a non-stop or one-hop trip to Edmonton from nearly every major city in the world.

Accommodation

There are more than 2,000 hotel rooms within walking distance of the Shaw Conference Centre. TWOSE has excellent relations with Edmonton Tourism, Travel Alberta, and the Edmonton Destination Hotels and we will work with them to ensure the best possible hotel rates, as low as US$85 and ranging up to US$150 per night.

Additionally, the University of Alberta has a significant number of student accommodation suites and, because it will be in the academic off-season, we have been assured of very reasonable rates for budget-minded participants. There is a modern light-rail subway system connecting the University of Alberta with the downtown core and the conference centre.

Theme and program

Alberta is known as Big Sky Country for its wide-open spaces and its big open skies. It’s where the big sky meets an infinite horizon. So the theme of the conference will be Big Sky—Think Big, Dream Big! What are the big opportunities for planetariums in the 21st century? We want discussions on how we will expand the horizons for the 21st century planetariums.

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by looking beyond the pre-rendered fulldome shows to ways in which we explore the possibilities of science visualization, artistic theatre, live science, and how this content is blended together with the new planetarium technologies. Since this is the IPS members’ conference, our planning process will involve as many IPS members as are willing to provide meaningful input.

We have also heard the comments from delegates about all those late nights and early mornings! Evening sessions in our plan will go to 10 p.m. to give delegates an adequate opportunity to socialize, network, and learn more informally from each other.

Other organizations, such as LIPS, IMERSA, and GSCA, will be encouraged to get involved in the early planning of the program.

TWOSE has hosted major international and national conferences, including the Association of Science and Technology Centres (ASTC) in 1998 and the Canadian Association of Science Centres in 2003, 200, and 2015.

A volunteer-oriented City

It would be difficult to find a community that gets more involved than Edmontonians do when a major national or international events comes to town. The city has a huge number of volunteers who relish the opportunity to get involved and to meet people from all over the world. Whether it is a major international sporting event or a scientific congress, people in Edmonton come out to volunteer in droves.

Before and after the conference

There are many possibilities to organize excursions to other scientific and educational institutions or to tourism destinations. The Alberta Oil Sands in Fort McMurray has a well-designed interpretative facility, and the TELUS Spark, Canada’s newest science centre, is located in Calgary. And, of course, the world-famous Calgary Stampede should be on everyone’s “bucket-list.”

Between Edmonton and Calgary, there are a variety of wonderful regional museums, including the Royal Tyrell Museum of Paleontology in Drumheller, just west of Edmonton, in the heart of the Canadian Rockies, Jasper National Park boasts the second largest dark-sky preserve in the world. The Skywalk and the Columbia Icefields are just a short drive south of Jasper along scenic highway 93. It is definitely a sight to behold; you may even see a bear!

Budget

The total budget for the conference will be developed in detail once the site is awarded. The aim is to keep the registration fee as affordable as possible. A combination of government and industry support will help keep the registration fee around US$500. We are anticipating an attendance of between 500 and 600. We will look for ways to sponsor or subsidize attendance by under-represented groups from different countries to ensure this conference reaches those who are in need of the talents of the IPS organization and members.

We will be working closely with previous IPS Conference hosts to ensure that we learn from their experiences to provide the best possible event for all IPS delegates.

20 years since last IPS in Canada

There have been only two IPS conferences in Canada: Vancouver in 1982 and Montreal in 2000. It’s been 20 years since the last one. Edmonton eagerly awaits and promises a professionally-run, fun, and memorable event. Recent hosts have set the bar very high, and we promise to continue the track record of quality for IPS. Come to Edmonton for the Big Sky experience in 2020!

Relevant websites:
- www.twose.ca
- exploredmonton.com
- jasperdarksky.org
emotional education

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Welcome to Space City, Houston!

The year 2020 is a critical year to relive more than 50 years of space history with the astronauts who walked on the moon, to experience what we’re learning and doing in space now, and to explore realistic tomorrows in orbit, on the moon, and on Mars. It’s all happening in Houston! Houston lives and breathes space. It was the first word spoken from the moon.1 Astronauts live here and it’s the birthplace of the new Orion program.

Houston is an easy destination from anywhere on Earth with its two international airports. Over 17 million people flew to Houston in 2015 and a million will come just for the Super Bowl in 2017. Over a dozen hotels with a range of prices are within easy walking distance of the light rail, which has a stop just two blocks from the Houston Museum of Natural Science.

Houston is 4th largest city in the US and is often rated #1 in quality and variety of restaurants. The Port of Houston is one of the world’s busiest seaports, and Houston will soon be a commercial spaceport as well. With 97 consulates/embassies and 145 languages spoken at home, Houston is the most racially/ethnically diverse large metropolitan area in the US. For every planetarian, Houston will feel like home.

1 Technically, it could be argued that the first word on the moon came from Buzz Aldrin, who reported “contact light.” Other mission-related discussion followed, until Neil Armstrong formally reported “Houston, Tranquility Base here. The Eagle has landed.”

Destination: The Houston Museum of Natural Science

All conference events will take place inside the air-conditioned and climate-controlled Houston Museum of Natural Science, except for your bus trip to the Johnson Space Center. All sessions, all domes, all demonstrations, all vendors, and all meals are under one roof. Every experience is convenient and no time is wasted in travel.

The museum is one of the best attended in the nation with two million visitors annually and is within Houston’s Museum District of 20 different cultural institutions.

For one week, August 23-29, we can use over 60,000 square feet (5,700 square meters) of teaching and meeting space after summer camps and before fall programs. Like a conference center, these 33 classrooms can be combined as needed, but they also retain the warm learning environment of a museum.

For IPS 2020, we will create a Space Place, Dome Village, DomePlex, Commons, and IPS University—all easily accessible on the museum’s lower level.

The museum’s Burke Baker Planetarium is currently the highest resolution digital planetarium in the world with over 50 million unique pixels refreshed 60 times a second (over 8,000 pixels on every meridian), a 1:20,000 contrast ratio, and a laser diode projection system with 21 computers and 10 4K projectors. The image is bright, sharp, and rich, making all films and demonstrations look their very best. The planetarium seats 191 and is scheduled for another projection system upgrade in 2020 before the IPS conference.

A negative pressure dome of at least 12 meters and several smaller domes also will be available for vendor presentations, live demonstrations, and film previews.

The museum’s 394-seat Wortham 3D giant screen theatre features the latest in state-of-the-art motion picture projection. Keynote sessions will be presented in this theater and simulcast in the planetarium. During each day of the conference, the museum will showcase 10 planetarium shows and 5 giant screen theatre films, with half of the tickets reserved for IPS participants. Winners from the pre-conference Dome Festival in Arlington will be featured on Friday. (See Pre-Conference Dome Festival)

In the museum’s Cockrell Butterfly Center, you walk through a three-story glass rainforest conservatory, built around a 50-foot waterfall with hundreds of live butterflies from around the world. In the museum’s Expedition Center (formerly the world’s first Challenger Learning Center), participants can fly a mission from the moon to Mars. Scenarios and crises are like those in real astronaut training.

The museum’s Morian Hall of Paleontology is larger than a football field and packed with prehistoric beasts. The Friday evening banquet will be held around and under the dinosaurs.
Other world-class museum collections include the Cullen Hall of Gems and Minerals and the John P. McGovern Hall of the Americas.

Visit to the Johnson Space Center
You will spend one day at the Johnson Space Center and the adjoining Space Center Houston. You can enter the shuttle replica Independence, mounted on top of the historic and original NASA 905 shuttle carrier aircraft. This is the world’s only shuttle mounted on an aircraft, allowing the public to enter both vehicles. Other exhibits include an Orion capsule, full size Apollo and Skylab models, as well as a moon rock you can touch.

On your VIP tour of the Johnson Space Center, you will visit the historic Apollo Mission Control, sit in the flight director’s chair and be amazed at the limited technology that took us to the moon. Apollo Mission controllers will join us during our visit. In Building 9 you will explore the full scale International Space Station components, including the cupola, a Soyuz capsule, a Shuttle cockpit, an Orion Trainer, as well as an assortment of robots and surface vehicles for other planets. Rocket Park at JSC features a Saturn V rocket with all its stages and engines.

Pre-Conference Dome Festival
The University of Texas Arlington will host a dome festival on Thursday-Saturday, August 20-22. With a 60-foot diameter dome, the Planetarium at UT Arlington is one of the largest and most sophisticated in Texas. The theater provides comfortable reclining seats for an audience of nearly 150. Winners at the dome festival will receive awards and be featured on Friday of the IPS 2020 Conference in Houston, the following week.

IPS 2020 Houston Schedule
Because the conference is under one roof, participants have many choices throughout the day and the opportunity to personalize the conference to meet their own needs, from watching films and live presentations, attending panel discussions and astronomy lectures, to spending time with exhibitors and visiting world-class exhibits—all available all of the time.

On Sunday (August 23), participants travel from their homes or from Arlington to Houston by car, express bus, or plane. Houston has flights arriving at IAH and HOU from the Dallas-Fort Worth Airport (DFW) throughout the day. Participants are invited to check in at the museum and spend Sunday afternoon exploring the museum district.

Monday (August 24) is reserved for check-in at the Museum and any pre-conference programs that exhibitors, sponsors, or planetarium associations would like to host. We have plenty of rooms! A juried cinema arts film festival provides evening entertainment.

On Tuesday through Friday (August 25-28), participants can choose from 10 planetarium shows in the Burke Baker Planetarium and 5 giant screen 3D films in the Wortham Theatre as well as museum exhibits and the Cockrell Butterfly Center. The IPS program will have interactive sessions in the Glassell Dome, Dome Village, Dome Plex, and IPS University. On Tuesday, Wednesday, and Thursday evenings, participants are divided into three groups for sponsor presentations in the planetarium, giant screen theater, and Glassell interactive Dome as well as a light dinner.

On Tuesday, you relive history as space pioneers tell their wonderful personal stories. Dr. Bonnie Dunbar, retired NASA astronaut and professor of aerospace engineering at Texas A&M University, will talk about being in space and the challenges of future spaceflight, including the importance of STEM education.

On Wednesday you have a space adventure at the Johnson Space Center and Space Center Houston. The Adventure includes the Space Shuttle on its 747, historic Apollo Mission Control, mock-ups of the ISS, Orion capsule, robots, rovers, and the enormous Saturn V.

On Thursday you learn about the latest astronomy discoveries, sponsored by the Rice Space Institute. This day also features guided tours of museum halls, fulldome photography in the Butterfly Center, an Expedition Center journey to Mars, exhibitor demos in the Glassell Dome and the portable (Continues on next page)
domes, software training sessions offered by exhibitors/vendors, animation and photography training sessions by participants/exhibitors/vendors, and workshops by the Lunar and Planetary Institute. Participants eat lunch on their own at the museum’s restaurants or while visiting nearby museums.

Friday begins with a keynote presentation on private sector space initiatives and the IPS awards ceremony. Two sessions of presentations, demonstrations, workshops, panels, and a picnic lunch follow. Winners of the Dome Festival will be featured all day in the planetarium. The evening begins with a keynote program on Tomorrow in Space: A Discussion on What, When, and Who presented by The Baker Institute for Public Policy, Rice University. The banquet will feature “Dining with the Dinosaurs” in the Paleontology Hall, followed by “Socializing under the Stars” in the Glassell Hall.

Saturday offers many options, from bus tours of Houston or Galveston to an evening at the Museum’s George Observatory. Participants can also depart for their post conference Maya Adventure in Yucatan, traveling by cruise ship or plane. Planetarians from Mexico will guide the tour of Maya Observatories at Chichen Itza and Uxmal. Cruises for 4-5 days are as low as $300 per person.

Why IPS 2020 in Houston?

- Houston has the easiest logistics and the lowest registration fee; just 3 steps from home to the museum conference center and a $400 fee, including the banquet and Johnson Space Center trip. All experiences are under one roof, allowing great flexibility in attending sessions, seeing films, visiting exhibits, talking with vendors, and meeting with friends—all just a short walk within the museum.
- The Houston Museum of Natural Science is one of the best-attended museums in the US, with over 2 million visitors each year.
- The Burke Baker Planetarium is currently the highest-resolution digital planetarium in the world with 8,000 pixels on every meridian and an upgrade planned for early 2020.
- The nearby Johnson Space Center is the home of the US spaceflight program, from Mercury to the ISS, Orion, and beyond.
- Many astronauts still call Houston home, as do scientists and engineers exploring the frontiers of astronomical research and space systems engineering.
- In Houston you can discuss and debate the latest astronomical discoveries and the future of human spaceflight with researchers and policy makers.
- Houston is the departure point for your cruise or plane flight to your Archaeo-Astronomy Adventure in Yucatan.
- Houston provides a personal space adventure where you can take home images, fulldome video, models, activities, materials, and memories to make astronomy personal and meaningful for you and your different audiences.
- This is your opportunity to capture, personalize, and archive a living history of the last 50 years of space flight, to discuss and debate the world’s space programs in 2020, and to take back the resources to give your audiences at home a glimpse of their own future in space.

IPS 2020 Houston partnerships

This is the team that will make IPS 2020 Houston a personal interactive experience to remember. Summary of Letters of Commitment from the Houston Community:

1. Houston Museum of Natural Science: staff, planetarium, logistics, conference center
2. Space Center Houston: management of VIP tours, exhibits
3. Johnson Space Center: providing presenters and facilities for tours
4. Lunar and Planetary Institute: keynote and session speakers, materials
5. NASA Alumni League: coordination of presentations by former astronauts
6. Rice Space Institute: astronomy research speakers
7. Baker Institute for Public Policy, Rice University: global policy, future of space, exploration, coordinated by George Abbey Department of Aerospace Engineering, Texas A&M University: Astronaut Bonnie Dunbar lecture on the future of human spaceflight and STEM education
8. National Center for Macromolecular Imaging, Baylor College of Medicine: workshops on medical fulldome and 3D imaging, including access to and importing of 3D models
9. Sasakawa International Center for Space Architecture, University of Houston: graduate student/professor presentations on designing for space, including 3D models
10. Houston Cinema Arts Society: Monday night film festival in planetarium/GST
12. Planetarios Digitales: guides for post-conference trip to Maya ruins in Yucatan
13. Tietronix: VR applications for museums and planetariums
14. E-planetarium and Go-Dome: coordination of custom domes
An artistic interpretation of the spherical, stereoscopic camera array from Micoy.
©Dan Neafus and Trent Grover
Filmmaking for Fulldome: Best Practices and Guidelines for Immersive Cinema (Part I)

Introduction

Over a century of cinematic history has produced not only an enormous catalogue of films, but also a rich understanding of how this medium has embedded itself into our cultural landscape.

The historical, sociological, and economic reasons for the rise of moviegoing are well documented (e.g., Schatz 1996; Thompson & Bordwell 2009). However, narrative filmmaking has also become as successful as it is today because filmmakers discovered ways to engage viewers with visual storytelling.

How we perceive and interpret not only simple visual elements—such as light, shape, and color, but also the more complex interplay of these inside the two-dimensional frame and within three-dimensional spaces—help shape the aesthetics of cinema, and, in turn, communicate information and emotions (Zettl 1998).

Master filmmakers understand how to combine and link such elements into a visual structure that supports a story throughout a film (Block 2008). Audiences are drawn to cinematic entertainment (as well as its artistic descendants such as television), in part, because of the effectiveness of the visuals in adding to the experience.

Fulldome cinema is another offspring of traditional cinema, with antecedents in the OMNIMAX® (now IMAX Dome®) films of the 1970s and 1980s, but whose flowering as a medium only began after the turn of this century. Although rooted in flat screen film, the fulldome medium has unique attributes that suggest different rules for effective storytelling. Informal guidelines have been adopted by fulldome filmmakers, but so far, to the best of our knowledge, these have not been codified.

In this first of a two-part paper, we make an initial attempt at doing so by reviewing past precepts and identifying our own prescriptions. We describe the critical ways in which the fulldome medium is different from traditional film and what that means for the filmmaker. We briefly illustrate the history of pacing in feature Hollywood films, giant screen cinema, and fulldome films; how they have evolved over time; and their consequences for filmmaking. If we accept that fulldome films are a type of immersive cinema in which the audience feels they are experiencing what is shown on screen, then it is possible to create a new theoretical framework of cinematic language and techniques which parallel those in traditional framed film. We outline the key elements of such a system of thinking, and show some examples from films that accommodate this theory. Finally, a dome display gives more directions where visual content can show up; viewers can miss critical on-screen information if they gaze in the wrong direction at the wrong time.

In Part II of this paper, we will identify directorial choices about what and how content is shown in order to mitigate this problem.

In both parts of this paper, we use actual sequences from fulldome films as examples for our analyses, and show frames from them to illustrate our points. Although there are many shows and producers that could have been highlighted, we chose films that we could carefully view while researching this paper, and hence represent a small but (we hope) representative fraction of all produced films.
Note that we are not attempting to describe how a filmmaker should work. We make no recommendations about what camera equipment or any other hardware to use, nor do we describe any modeling and animation software, nor any detailed production pipelines. The two papers in this series will describe a few useful tools that will impact how a production proceeds, but their primary goal is to get directors and producers to consider why visuals work the way they do in fulldome, and to think about structuring their shots—whether live action or computer-generated—to create the greatest impact for the story they wish to tell.

**Fulldome attributes**

Fulldome cinema in domed theaters is a very different medium than traditional cinema: instead of projections on a flat screen in front of the audience, the hemispherical display surrounds the viewers, immersing them in imagery and sounds. Depending on whether the theater is level like a traditional planetarium (Fig. 1a), or is tilted with seats placed at an incline (Fig. 1b), audience members have their visual fields filled by the dome. In fact, unlike a traditional theater, imagery can extend to 180° in both the horizontal and vertical directions, far beyond what the viewer can take in at once.

By comparison, an IMAX® screen (Fig. 1c) fills a lateral field-of-view (FOV) of 60° to 120°, and a 40° to 80° vertical field, while the hemispherical OMNIMAX® expands on this to 180° laterally but only 130° vertically (Shaw & Douglas 1983).

Having such an expansive screen for projected imagery means that many more pixels are required to fill it. The highest resolution domes today can be filled with a fisheye reference domemaster frame that stretches at least 8,000 pixels across multiple meridians (e.g., the “True 8K” projection system at the Houston Museum of Natural Science’s Burke Planetarium; n.a. 2016.).

In today’s digital cinemas, 4K projectors have resolutions of 4096x2160 (Jukic 2016). If we compare the resolution that is visible to an audience member in a dome theater, who cannot see the entire domemaster at once, but can only have a binocular view (with both eyes) of 180°x110° at a time (Dragoi 1997), then the visual field visible in the 8K domemaster in the forward direction has greater resolution than that of a 4K cinematic frame (Fig. 2). But even with such a wide visual field, the viewer only sees content at high visual acuity (or resolution) in the foveal part of the retina, which is only a few degrees across (represented by the black dot in Fig. 2). Our perception of the world around us is built up piecemeal by the dynamic rapid scanning and fixation with the fovea in the eyes (Yarbus 1967).

The domes of fulldome theaters range from a few meters to 30 meters in diameter. Even the smallest theaters are highly immersive, since the dome’s display surface can fill the FOV immediately visible to a viewer. The sheer physical size of the domed theater (and the similar scale of the displayed imagery) is one of the most memorable elements as noted by audience members in surveys. For instance, 22% of 161 written audience responses from the general public cited the size of the visuals as what they enjoyed most about live presentations focused on Earth (Yu 2009). Follow-up oral interviews again mentioned the screen size as an important part of the experience, with multiple respondents highlighting the ease of visibility of the images on the dome compared to a rectangularly-framed presentation in a regular auditorium.

That such large displays are memorable is not surprising. Research comparing televisions with different screen sizes showed that the largest screens increased arousal (the physiological state of being alert, awake, and ready for action), and commanded the greatest attention (Reeves et al. 1999), while action on large screens was rated by viewers as being more intense (Lombard et al. 1997), and movement was viewed as faster, more exciting, and led to a greater sense of physical movement (Lombard et al. 2000). The combination of a physically large display and wide FOV is suspected of leading to greater learning gains in undergraduate students who viewed a live dome astronomy presentation (Yu et al. 2016). A fundamental difference between fulldome films (and its counterpart virtual reality) and traditional cinema is that the latter assumes a rectilinear (also known as linear, geometric, or classical) perspective, where the image at the picture plane represents a single viewing position and direction.

Rectilinear perspective was perfected in the Renaissance with precise mathematical rules for determining the relationship between object size and distance. Artwork created using these rules resulted in objects that appear smaller the further they are from the eye. Objects near the center line-of-sight appear normal in rectilinear perspective. However, as an object is displaced laterally to the left or right, they look distorted because their projections are farther away (and at a greater angle) on the image plane (Fig. 3a, based on the...
example from Leonardo 1883, p. 63). Leonardo da Vinci was the first to suggest the alternative curvilinear (or synthetic) perspective where instead of a flat projection plane, a curved one is used. In this case (Fig. 3b), the sizes of objects are preserved correctly no matter where they appear. Curvilinear perspective therefore is an attempt to represent the undistorted view that we get when we turn our heads and eyes to examine our environment in all directions. By filming or rendering imagery in a perspective that matches the geometry of the curved screen, fulldome filmmakers are creating a visual experience that mimics the visual experience that we have as we inhabit our real-world environment.

**Frames for a frameless medium**

In giant screen cinema, the projected image is so large that the edges of the frame are at the edges of one’s visual field and can effectively “disappear.” Viewers can still turn their heads to see the edges of the giant screen frame, however. The visual experience in fulldome goes even further because even the edges of the dome disappear inside a hemispherical space. Although Shedd (1989, 1999) makes a convincing argument that frames in fulldome do not exist in the same sense as in traditional cinema, we feel that a “frame” can still be defined in a way that is useful for fulldome filmmakers.

As an example, let us use the Denver Museum of Nature & Science’s (DMNS) Gates Planetarium (Fig. 1b), which has raked unidirectional seating and a dome tilted at 25°. Seated audience members’ views of the dome surface depends on the location of their seats and how far back it is reclined. We can define the view as seen by a “reference” theatergoer seated comfortably with head resting against the seatback, gaze naturally pointed forward in a neutral position, with no pronounced head tilt to one side or up or down. This individual will find the combined binocular visual field (using both eyes) to be about 180°x110° (Dragoi 1997; also see Fig. 2).

In Fig. 4, we show a fisheye view of the Gates Planetarium dome, with a grid marking out degree increments and major grid lines every 5°. The forward direction of the dome as viewed by the audience is at the bottom of the image, while the back of the dome is at the top of the image. Since the dome is tilted by 25°, the actual zenith is located 25° above the center point of the fisheye.

For an individual seated in the center seat of the front row, the limit of what is visible is bound by the green line and the front edge of the dome in Fig. 4. The front row seats lean back enough to allow content 45° from the zenith to be visible at the top edge of one’s vision. The viewers will have to crane their necks or twist their bodies around to view action that occurs behind the green line. Similarly, people seated in the seats closest to the center of the auditorium will have their view delimited by the yellow line. Because the seats in the center of the house do not lean back as far as the front row seats, the range of visibility is actually quite similar to that of someone from the front row. Finally, the red line shows the edge of what is visible to someone in the back row center, with the rear perimeter running close to the actual zenith of the room.

Through experiments at Gates, we discovered that a projected horizon shown in the dome could be within a range of angles away from the viewer’s personal horizon without feeling “wrong” (Yu et al. 2007; also see IMAX Corp. 1999, p. 9). Because the Gates Planetarium is tilted by 25°, the audience’s real-life horizon would cross 25° above the front edge of the domemaster. In Fig. 5, a horizon did not look unrealistic if it was offset (tilted) with respect to the real horizon anywhere inside the blue region. Thus horizons tilted lower down were acceptable, as well as ones tilted up to almost 30° above the viewer’s natural horizon. The perceptual flexibility when deciding whether a horizon looks tilted or not is fortuitous since the apparent tilt of a horizon will also depend on where an audience member is seated in the theater.

The audience visibility and horizon maps in Figs. 4 and 5 came about during the production of the film Black Holes: The Other Side of Infinity (Yu et al. 2007), when versions of them were provided to animators and visualizers as a guide for shot composition. It is specific to the dome tilt and seat lean back angles at the Gates. A map can be evaluated for every seat in the house, but for simplicity’s sake, it was decided to have the boundaries defined by the middle seats in the front, center, and back rows. The lines that circumscribe the audience members’ views of the dome in these rows help determine where the visual “safe area” is located. Visual content must be placed forward of the green line in Fig. 4 in order to be visible to anyone seated in any center seat from the front to the back row without moving their heads. If a visual element is placed outside of the front row safe area, the viewer must be cued to turn and look in a direction that she was not looking before. We will describe ways that this can be done in Part II.

Because Fig. 4 was developed specifically for DMNS’ Gates Planetarium, a corresponding diagram for another dome theater with unidirectional seating will differ in the details, but we would expect it to look similar. For a dome with concentric or epicentric seating, it may not be possible to define a safe area that is equally visible everywhere in the theater outside of the zone around the zenith. For imagery located near the edge of the dome-master, the virtual camera will have to “pan” the visual content so that it “circulates” around the dome in order to be noticed by all audience members. Ideally an individualized visibility grid should be tailored for each theater. But pragmatically, a film producer will likely use just one map to guide content placement for all unidirectional tilted theaters, and a second one for concentric and epicentric theaters.

**Slowing action for giant screens**

When filmmakers started working in giant screen cinema, they had to modify the traditional filmmaking techniques they had learned previously. First, they argued that large format films need to be slower paced than traditional cinema. That is, the individual shots need to be longer so that a film would have fewer cuts and total number of shots. IMAX® and OMNIMAX® directors recog-
nized that the frame was so large that viewers needed time to scan the image and take it all in (Tilton 1973; MacGillivray & Freeman 1976). Directors found that IMAX® films could stimulate a viewer’s wonder with views of awe-inspiring natural phenomena, the use of wide vistas, and soaring aerial shots (Crosby 2007).

When the audience is immersed inside a “frameless” flight over a landscape, the camera motion translates into the entire on-screen environment moving. The audience’s view is filled almost entirely with these cues suggesting that they that are moving. Instead of a secondhand experience of viewing the subject of a film from afar, the audience perceives that they are experiencing what is happening on-screen to them in first person (Shedd 1989). When the audience is taken on an aerial flight, the filmed horizon dominates the visual field so any pitching or banking by the camera results in the audience feeling that they and the entire theater are experiencing that motion (Shedd 1999).

The sweeping camera movements can lead to this appearance of movement because of vection, the sensation of self-motion even when the observer is stationary. Experiments show that if viewers see apparent motion in their peripheral vision, the resulting vection produces an illusion of self-motion. Conversely, if motion appears only in the center of the visual field, the subjects feel that only the object in the scene is moving while they remain stationary (Brandt et al. 1973). The generation of vection explains why giant screen cinema and fulldome films can be more involving for the audience.

Unfortunately, this involvement can also cause viewers to develop simulator motion sickness due to the disparity between the audience’s inner ear vestibular systems which suggest they are motionless, and the visuals which give the illusion that the audience is moving. Increasing the rate of motion and widening the FOV so that more of the visual periphery is stimulated are two factors that can worsen motion sickness (LaViola 2000).

Another reason for slowing the action has to do with a visual artifact when objects move too fast on film. An object in motion will appear at different positions in its trajectory in multiple consecutive frames. When projected at normal speed, persistence of vision fuses the individual appearances into the apparent continuous motion of the object. When the screen is too large, however, a moving object will strobe as a series of offset images (Shedd 1998). For giant screen filmmaking, Shedd (1989) recommends that camera pans should move no faster than about 1 degree of arc per second of time in order to minimize this problem. Alternatively, motion blur can be used to smooth over the effect.

Cuts and other transitions that lead to new scenes can be disorienting in immersive cinema as well. Shedd (1989) describes the phenomenon of “instant subtraction,” where an object the audience has been looking at suddenly disappears with the onset of a cut. The pacing of the film (how quickly the edits occur) has to be reduced to minimize such subtractions to the audience experience. A film that is cut with a rhythm that looks normal on a normal movie theater screen will appear too fast-paced for the dome. Early
OMNIMAX® filmmakers doubled or tripled the length of shots to give viewers time to scan the larger image and adjust to the new scene (Tilton 1973; Wollen 1993).

The above guidelines have been adopted by many fulldome filmmakers. But since fulldome theaters have such wide FOVs, some directors have slowed the camera motion and pacing in their productions even more to avoid motion sickness. The number of shots and cuts in many fulldome films were reduced to a bare minimum. For instance, the first production from the American Museum of Natural History (Passport to the Universe, 2001) consisted of just four individual shots. Camera motion did not disappear despite this. Similar to the soaring aerial shots of IMAX®, virtual flights through space were compelling experiences, and could be used to impart information, such as the graceful spiraling camera motions in Passport to the Universe that conveyed the dimensionality of astrophysical phenomena (Sweitzer 2001).

Following Shedd’s description of the audience experiencing instead of watching the events on-screen, one can argue that a fulldome cinematic tour is akin to experiencing a journey, rather than merely watching it. For the best audience experience, it follows then that the visual journey should be visually continuous, and the storytelling should be carefully tailored to the virtual trek. There should be a tight integration of narration and visuals, especially since many fulldome shows are about astronomical locales that are unfamiliar to the public. This cumulative experience has been called the “narrative journey” (Wyatt 2005), where the visual tour is augmented by a narration track to create “an intellectual and affective excursion reinforcing the itinerary.”

Pacing of theatrical features, IMAX®

Despite the convention of reducing the pacing of large screen films, there have been many recent counter-examples to this paradigm. Since 2002, Hollywood movies produced originally in traditional 35-mm film (or its digital equivalent) have undergone Digital Media Remastering (DMR) for exhibition in IMAX® screens (Heuring 2008). Hollywood productions are now even shot natively in digital IMAX® cameras (with the frame cropped for projection in conventional theaters; Lang 2016). How can such faster-paced feature films be shown and be successful on giant screens, given what we have noted above? Do fast-paced IMAX® films mean that fast-paced fulldome films are also possible?

To examine this question, we first investigated the pacing of traditional Hollywood feature films, which can be quantified by the average shot length (ASL) of a film, determined by taking the total length of the film and dividing by the number of cuts or edits. Analyses show that Hollywood silent features in the 1920s were cut quite fast, with many having ASLs in the 4-6 sec range (Bordwell 2006, p. 121). With the advent of sound, pacing and camera motion slowed down as equipment proliferated and became bulkier (Bordwell 2006, p. 145). Fig. 6 shows the average ASLs as calculated by Salt (2009) for films from 1930 to 2005.

Starting with a high of more than 11 sec in 1930, the average ASLs decreased by almost a factor of three by the 21st century. There is a bump up in shot lengths during the period 1947-1955 due to the advent of CinemaScope and other widescreen film formats. Directors, producers, and editors slowed down the pace of these films with longer takes. But once it was realized that audiences could handle faster cutting, the ASLs started falling again.

Although the drop in ASLs has been criticized as part of a trend of incoherence in recent blockbuster films (e.g., see the discussion of “chaos cinema” by Stork 2011a, 2011b), analyses of cinematic trends show that film storytelling has not fundamentally changed (Bordwell 2006). Filmic techniques that originally evolved in the 1910s and 1920s are still being used, but in different proportions than that found in the “classical” Hollywood studio period that lasted until the 1960s.

The new style that has evolved in recent decades is called “intensified continuity” by David Bordwell, who cites not only rapid editing, but also the mixed use of wide- and narrow-angle lenses, close framings in dialogue scenes, and moving cameras as hallmarks of this modern aesthetic. What is important to note about intensified continuity is that this style is not restricted to just action films. Bordwell points out that starting in the mid-1960s, films of all genres—including dramas, comedies, romances, and musicals—started adopting faster-paced editing, and even directors known for slower paced features in the past started making films with contemporary pacing (Bordwell 2006, pp. 121-124).

The historical pacing of IMAX® films has not been rigorously studied. But in Table 1, we list the ASLs for a number of IMAX® films that we could find in the literature as well as from our own timings (where no footnote is given for a citation). The list includes one of the earliest IMAX® films (North of Superior) as well as the OMNIMAX® film The Dream Is Alive. When compared with Fig. 6, the slowest paced IMAX® films have ASLs that are twice the length of the slowest U.S. feature films from the 1930s and 1950s. However, many giant screen films over the years have ASLs approaching the maximum mean U.S. feature film ASL values of 10-11 sec, including North of Superior and Tropical Rainforest (directed by Ben Shedd). By the late 1990s and the early 2000s, some large screen films have ASLs that drop below 10 sec, approaching average Hollywood feature film ASLs from the 1970s.

The popularity of films like Pulse: A Stomp Odyssey (61 sec ASL) shows that faster-paced giant screen films are possible. Instead of just a few locations, this film ventures out to cover dancers and musicians in locales on five continents. Each set piece contains from one to...
hundreds of performers. The scenes are edited together from shots from multiple camera set-ups, including close-ups (showing performers shoulders and up), medium (waist and up), and long shots (showing entire bodies); dolly shots where the camera is moving on tracks or on a Steadicam, and crane shots with the camera rising up or down in the air.

The film remains watchable (with a 93% critics score on RottenTomatoes; www.rottentomatoes.com/m/pulse-a-stomp-odyssey/) even when the pacing drops to a quick 4.1 sec ASL (in the sequence with the timbalada drummers in Salvador, Brazil) because the main focus of most shots is the human body, with faces that easily draw attention (for more on this, see Part II). The performers are often in the frame center (or close to it) also making it easy to stay focused on the action after each cut.

When there are multiple performers, they are lined up across the horizon or massed throughout the screen, meaning there is not just one location the director wants the audience to look at; the viewer has the freedom to shift attention to multiple points on-screen.

Nucci (2005) notes that films like Pulse: A Stomp Odyssey goes against the conventional wisdom about how fast editing for giant screen films could be, but also other edicts such as that performers must not appear on-screen (Tilton 1973). Nucci believes that since IMAX® films have been dominated by educational films, this genre has set the norm for what is permissible in giant screen filmmaking. Thus nature documentaries are often filled with landscapes which demand stationary shots for viewers to take in vistas, while grand, swooping aerial views of the same also require long shots. This type of slow-paced filmmaking became the prevailing style of giant screen cinema, even though there are not any technical limitations to prevent filmmakers from doing otherwise (Nucci 2005).

Films such as Pulse and NASCAR 3D demonstrated that faster-paced giant screen films could not only be made, but also be popular with audiences as well. Although the films in Table 1 have ASLs no faster than the average Hollywood features from the 1970s to the 1980s, they portend the appearance of even faster Hollywood movies that would appear on IMAX® screens courtesy of DMR.

**The Pacing of fulldome films**

_The Dream Is Alive_ is the only OMNIMAX® film in Table 1, and is a harbinger of how fast fulldome films could possibly be cut. In fact, the limited listing of fulldome ASLs in Table 2 suggest that many (and perhaps most) fulldome films are much slower paced than even OMNIMAX® films. Even the fastest-paced film in our small sample, _Wildest Weather in the Solar System_ with 21 sec ASL, is only as fast as the giant screen films from the early 1990s, and have shot lengths about twice that of the average Hollywood feature from the 1930s to 1950s. As the preceding analysis shows, there is no technical or perceptual reason why fulldome films need to be as slow as they are. They could but are not cut even as fast as an OMNIMAX® film.

In the end, constructing a film with so few shots is a conscious stylistic or educational choice by a filmmaker. The final two films in Table 2 are from the California Academy of Sciences and are directed by one of the authors (Wyatt). They exemplify the narrative journey approach to storytelling, using continuous camera motions with a minimal number of edits. _Habitat Earth_ consists of eight scenes, while _Incoming!_ has just two long shots.

Many space science fulldome films employ a smooth flight via a single camera maneuvering through planetary and astronomical datasets. This was the style of the early fulldome film Passport to the Universe (2001), which introduced the now standard navigational arc of starting on or near Earth before launching the viewer into deep space. This format was repurposed and reversed for the non-astronomical show Life: A Cosmic Story (2010; Wyatt et al. 2012), which starts in a redwood forest but then zooms into smaller scales until the audience is viewing the animated motions of molecules engaged in photosynthesis inside a plant cell.

But this is also a navigational paradigm intrinsic to planetarium visualization soft-

(Continues on page 34)

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1 The two are #11 and #33, respectively, in a list of top grossing IMAX® films of all-time; www.boxofficememo.com/alltime/domestic/imax.htm.

---

**Table 1: Average shot lengths of IMAX® films.**

<table>
<thead>
<tr>
<th>IMAX® Film</th>
<th>Year</th>
<th>ASL (sec)</th>
</tr>
</thead>
<tbody>
<tr>
<td>North of Superior</td>
<td>1971</td>
<td>10.7</td>
</tr>
<tr>
<td>The Dream Is Alive†</td>
<td>1985</td>
<td>17.0</td>
</tr>
<tr>
<td>Blue Planet</td>
<td>1990</td>
<td>19.5</td>
</tr>
<tr>
<td>Tropical Rainforest</td>
<td>1992</td>
<td>13.5</td>
</tr>
<tr>
<td>Destiny in Space</td>
<td>1994</td>
<td>21.1</td>
</tr>
<tr>
<td>Yellowstone</td>
<td>1994</td>
<td>10.7</td>
</tr>
<tr>
<td>Alaska: Spirit of the Wild</td>
<td>1997</td>
<td>7.2</td>
</tr>
<tr>
<td>Search for the Great Shark</td>
<td>1999</td>
<td>8.7</td>
</tr>
<tr>
<td>Pulse: A Stomp Odyssey</td>
<td>2002</td>
<td>6.1</td>
</tr>
<tr>
<td>NASCAR 3D: The IMAX Experience</td>
<td>2004</td>
<td>6.0</td>
</tr>
<tr>
<td>Dinosaurs Alive!</td>
<td>2007</td>
<td>11.2</td>
</tr>
<tr>
<td>Rescue</td>
<td>2010</td>
<td>10.4</td>
</tr>
<tr>
<td>Wild Africa 3D</td>
<td>2015</td>
<td>5.2</td>
</tr>
<tr>
<td>National Parks Adventure 3D</td>
<td>2016</td>
<td>11.1</td>
</tr>
</tbody>
</table>

1 Crosby 2007
2 Nucci 2010
3 Cinemetrics 2016
† OMNIMAX® film

**Table 2: Average shot lengths of a sample of fulldome films.**

<table>
<thead>
<tr>
<th>Fulldome Film</th>
<th>Year</th>
<th>ASL (sec)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cosmic Journey</td>
<td>2003</td>
<td>54</td>
</tr>
<tr>
<td>Black Holes: The Other Side of Infinity</td>
<td>2005</td>
<td>41</td>
</tr>
<tr>
<td>Earth’s Wild Ride</td>
<td>2005</td>
<td>30</td>
</tr>
<tr>
<td>Wildest Weather in the Solar System</td>
<td>2011</td>
<td>21</td>
</tr>
<tr>
<td>Super Volcanoes</td>
<td>2012</td>
<td>47</td>
</tr>
<tr>
<td>We Choose Space</td>
<td>2012</td>
<td>24</td>
</tr>
<tr>
<td>Dark Universe</td>
<td>2013</td>
<td>101</td>
</tr>
<tr>
<td>Habitat Earth</td>
<td>2015</td>
<td>183</td>
</tr>
<tr>
<td>Incoming!</td>
<td>2016</td>
<td>766</td>
</tr>
</tbody>
</table>
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Table 3: A list of types of camera shots and movements in traditional cinema with their complements in our theory of immersive cinema.

<table>
<thead>
<tr>
<th>Traditional Film</th>
<th>Fulldome Film</th>
</tr>
</thead>
<tbody>
<tr>
<td>Close Up</td>
<td>Near</td>
</tr>
<tr>
<td>Wide</td>
<td>Far</td>
</tr>
<tr>
<td>Zoom In/Zoom Out</td>
<td>Approach/Retreat</td>
</tr>
<tr>
<td>Cut</td>
<td>Transport/Jump</td>
</tr>
<tr>
<td>Reverse Angle</td>
<td>Orbit</td>
</tr>
<tr>
<td>Sequence</td>
<td>Camera Path</td>
</tr>
</tbody>
</table>

A Theory of Immersive Cinema

Traditional film has built up a repertoire of cinematic language that describes the fundamental elements of shots or scenes, and this language can be used by giant screen and fulldome filmmakers. However, as Ben Shedd has pointed out (1989) and as described in §4, another paradigm exists where the film frame disappears and what is shown can be thought of as an environment that the audience feels is personally experiencing. Here, we describe a theoretical framework where we assume as given the fundamental axiom, Action is happening to the audience, instead of being viewed on-screen by the audience. We can then ask, how do we re-frame cinematic language for fulldome so that the vocabulary is centered around the audience experience?

We propose a short list of terms from traditional cinema in Table 3 with their corresponding re-framings in immersive cinema. The list above is not meant to be complete, but is intended to start a dialogue for others interested in exploring this model and re-thinking these basic filmmaking concepts. We stress that this theoretical approach to immersive cinema is neither the only filmmaking style that can be applied to fulldome film, nor even what is recommended in some situations. Our earlier discussion of Pulse: A Stomp Odyssey shows that there are no absolute rules that apply equally in all situations for giant screen film. But by organizing the results from this assumption of audience immersion, we propose a common vocabulary to promote further discussion and exploration. Filmmakers can help confirm or invalidate elements of this theory with examples from their films, and researchers can do the same with audience studies.

Based on our fundamental axiom of immersive cinema, the audience occupies the same environment as the characters in the film, and distinctions erode between shots that are objective (distant and independent) and subjective (personal point of view). The audience member becomes a participant, and it follows then that immersive filmmaking is inherently a subjective experience. Hence, while static camera setups in traditional cinema that use lenses to control the visual field of what is visible on a framed screen, terms such as “close up” and “wide” shots describe how much the object of interest—often a person—fills the screen.

For instance, a close up, when in reference to an actor, describes a shot in which the actor is visible in frame from the shoulders to the top of the head (e.g., Katz 1991, p. 122). In immersive cinema, there is no frame to help define what type of shot has been set up. Although fulldome content can capitalize on small variations in the content’s angle of view (AOV) without excessive distortion, the medium cannot tolerate the dramatic changes in camera AOV that traditional cinema frequently employs. Thus designations such as “close up” are highly subjective, especially for viewers in different parts of the theater. Instead, we propose describing shots in terms of the physical location and movement of the camera (and by proxy, the viewer) within the filmed scene.

When an audience moves away from an on-screen subject, that subject appears smaller as more of the surroundings are revealed, creating the appearance of a wider shot. This is not done by an optical zoom but by moving the audience viewpoint from one location to another. Thus a wide shot or establishing shot is a viewpoint that is far away from the subject, revealing more of the scenery around the subject. In a close-up, the subject has a larger AOV, and fills up more of the visual field.

Camera motions have an exact correspondence to the perceived audience motion in immersive cinema. Tracking (or dollying) in and out is equivalent to the audience moving forward and backward; tracking left and right translates into lateral motion for the audience. Crane shots that allow a camera to shift vertically give the viewer a sensation of upward or downward motion. Camera pans to the left and right or tilts up and down result in similar changes in orientation for an audience member.

A cut occurs when a scene transitions from one camera placement to a different one in either the same scene or a completely new one. In immersive cinema, this results in an instant teleportation of the audience into the new location. If the new scene is distinctly different from the old one, it may take a second or more for a viewer to orient himself. The commonly used technique of cutting between two opposite viewpoints in a dialogue scene (commonly noted as a ‘jump cut’ in traditional cinema) is neither the only filmmaking style that can be applied to fulldome film, nor even what is recommended in some situations. Our earlier discussion of Pulse: A Stomp Odyssey shows that there are no absolute rules that apply equally in all situations for giant screen film. But by organizing the results from this assumption of audience immersion, we propose a common vocabulary to promote further discussion and exploration. Filmmakers can help confirm or invalidate elements of this theory with examples from their films, and researchers can do the same with audience studies.

(Continues on page 36)
DINOSAURS Q DUSK
the origins of flight

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ly called a reverse angle shot) becomes jarring when considered in the context of immersive cinema. A compromise technique may be to “orbit” the camera around the two subjects, so that a continuous frame of reference is maintained, as the camera (and audience) circumnavigates through different points of view of the actors. Similarly, a series of edited shots can be replaced with a single unbroken shot. Through camera movement along a carefully-devised camera path, the visual story develops by what is visible or is revealed to the audience as they are taken on this journey.

Camera Reveals and Hiding Edits

How can we use this theory of immersive cinema to make sense of how fulldome film works? Let us take the last example of a continuous camera path that takes an audience through a scene. This camera path defines the audience experience in narrative journey-style fulldome films. If the camera travels linearly along a path and there are no edits to instantaneously transport the viewer from one camera point-of-view to another, it would be difficult for the viewer to be surprised by anything within the scene. The slower camera motions that are necessary in fulldome film means that a new element that appears in the distance will gradually grow in size as the camera approaches it. Unless the object appears from behind the audience or just beyond the edge of the dome (spring line), it will be hard to miss.

A way around this is a dedicated reveal. Here a foreground element or the edge of the screen eclipses something further in the background. Some combination of camera or object movement can result in the object emerging and revealing itself to surprise the audience. One such example can be found in Peter Popp’s _Realm of Light: A Brief History of Life_ (2009), where a cluster of dark asteroids float in the foreground, obscuring something glowing in the distant background. The audience is attracted by the mysterious light which is revealed as the camera (and the audience) navigate through the floating debris field, slowly exposing a giant red star looming in the distance (Fig. 7).

In many cases, it may be difficult or impossible to create a single continuous shot that includes all of the scenes shot or created for a film. It will be necessary to join together a mix of disparate shots. If we follow our theory of immersive cinema, we want to minimize disruptions to the audience experience. Multiple solutions showing how this can be done can be found in Android Jones’s _Samskara_ (2016), an art film inspired by Vedic myth and Sanskrit mantras, consisting of flight through labyrinthine computer-generated scenes populated with densely detailed imagery. Although the visuals appear to consist of

(Continues on page 38)
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one long, continuous shot, they are actually constructed from multiple scenes connected by subtle dissolves and wipes. There are edits throughout the film where an entire environment can change without the viewer immediately noticing that it is happening.

Our first example is at the end of a scene with the camera moving past the blue-gray feather-adorned headdress of a monolithic figure, with several orange, hollow polyhedral shapes further ahead, and a dense background of texture and detail everywhere else (Fig. 8a). As the camera passes by the orange polyhedra, they and the rest of the scene darken (Fig. 8b). A deep red-magenta trilobal pattern fades up in the center of the viewer’s visual field (Fig. 8c), and grows as it animates with a rapid pulse. Since attention is drawn to this dominating feature, the viewer is less apt to notice the change elsewhere on the dome, as the original background darkens and a dissolve leads to a new starry background (Fig. 8d). The animating pattern quickly fills up the entire screen, so the new background is covered up before the viewer has a chance to reflect on it.

A wipe is a film transition where a new shot replaces an old one by traveling across the frame. These tend to be noticeable if the two shots are very different looking. However, Samskara has subtle wipes by objects, where a foreground object moving through the shot helps hide the effect. In Fig. 9a, the camera is headed towards a point above the reddish-orange head of another giant figure. Two butterflies appear high up and off to the left and right, meaning they are in the viewer’s peripheral vision if she is looking forward towards the direction of motion. (See the two series of overlapping wings emerging in Fig. 9b.) Other butterflies flit through the shot, but only those two get close enough to the virtual camera to momentarily fill up the entire domemaster frame (Fig. 9c). Their movement provides cover for the background scene to disappear and be replaced by a new one (Fig. 9d).

Another wipe by foreground object helps hide a jump between two diametrically opposite camera angles near the end of the film. In this scene, the camera has been pirouetting around a demonic head that is lit orange, complementary to the deep blue that dominates the shot. The environment is filled with geometrical blocks consisting of skyscraper-like shapes, including spires that resemble the Empire State Building. In Fig. 10a, a foreground element consisting of skyscraper blocks emerges from below the bottom of the frame, just to the right of the head. The camera tracks left as the foreground mass of skyscrapers grows and also moves left. The foreground skyscrapers, now grown to a triangular mass, shift to completely block our view of the towering head, with only its red tongue still not completely cut off on the left in Fig. 10b.

A wipe to a new scene starts in Fig. 10c, with the shape of the wipe matching the boundary of the triangle of skyscrapers. Notice the new background building appearing where the tongue was in Fig. 10b, and the mirrored bright clump of the Milky Way to the right of the skyscraper triangle in the incoming shot, while the bright clump from the previous shot is still visible in the back of the dome (top of the domemaster frame). The wipe grows to encompass the rest of the shot; the background building seen earlier is now revealed to be the Empire State Building, the top of it glowing blue against the Milky Way (Fig. 10d).

As the camera continues to track left in Fig. 10e, the triangular block of buildings in the foreground moves off to the left, and we see that the camera is now on the opposite side of where it started relative to the demonic head in Fig. 10a. The position of the Milky Way has also flipped in the sky. Throughout this transition, the triangular block of skyscrapers dominates the shot with its size, central position, and motion, drawing the viewer’s atten-
tion, even as the rest of the scene around it completely changes.

**Coming next:**
This ends Part I of our two part paper. In the next issue, we look further into how a full-spherical display.

**Acknowledgments**
We thank Peter Popp and Android Jones for permission to use images from their films. We also thank Kathy Honda for help with our library research.

**References**


Can young children understand the complex science of astronomy? While 3- to 5-year-old children are not fluent in reasoning about astrophysics, they are keen observers of the world around them, including the changes they see in the day and night sky. How can we build children’s curiosity about the sun, moon, and stars to encourage early engagement with practices of science—observing, predicting, modeling, and explaining?

Goals of the My Sky Tonight project
My Sky Tonight is a National Science Foundation-funded project with the goal of advancing efforts to engage young children in astronomy learning in informal settings. The project contributes in three key ways: by providing a toolkit of developmentally-appropriate astronomy activities for use with young children in informal settings, by supporting educators through professional development and materials, and by disseminating the results of research conducted on young children’s interest and engagement in astronomy through the My Sky Tonight activities.

Our project has been broadly focused on exploring young children’s capacity at engaging with astronomy concepts through well-tested activities across a multitude of settings and with educators from across the country. Our partners in developing and testing these activities include the Lawrence Hall of Science, Children’s Discovery Museum of San Jose, San Luis Obispo Children’s Museum, and the Discovery Space of Central Pennsylvania.

Young children’s learning often happens in the midst of play, imagination, and storytelling, rather than in explicit lessons. Teaching 3- to 5-year olds through detailed verbal instruction or by encouraging rote memorization is not effective, nor does it inspire sustained interest. Therefore, our focus in this work has included attention to the principles of “Developmentally Appropriate Practice” as outlined by the National Association for the Education of Young Children (NAEYC; www.naeyc.org). These principles acknowledge that young children learn through play and exploration as well as through verbal explanation, and that children’s learning varies widely across ages, individual interests, and experience. Additional guidance was drawn from empirical research in developmental psychology and early childhood education.

The My Sky Tonight activities were designed to be used in facilitated workshops and as drop-in activity stations on the floor of museums, but we often also have members of the planetarium community attend our online professional development workshops. Planetarians have been enthusiastic participants in the workshop discussions and field-testing of activities. Further, reception from an audience of planetarians at the 2016 International Planetarium Society meeting in Warsaw, Poland suggested a broad international interest from the planetarium community in astronomy activities that can be done with very young children.

Therefore, the goal of this article is to share some of the philosophy and research behind the My Sky Tonight activities, introduce a few activities we think may be of interest to the broader planetarium community, and suggest ways these activities can be connected to the planetarium, based on our experiences with field-testing in the planetarium at Pennsylvania State University, University Park and on feedback from the My Sky Tonight workshop participants.

Children’s interest in astronomy
In several preliminary studies, we investigated the target audience’s conversations about astronomy in everyday settings using three different methodologies:

- A diary study of family conversations about nature,
- Children’s conversations in a preschool classroom during an astronomy unit, and
- Family conversations in several museum workshops that tested preliminary astronomy activities.

Julia D. Plummer, Chrysta Ghent, Michele Crowl, Maureen Callanan, Suzanne Gurton, Anna Hurst, Jennifer Jipson, Sasha Palmquist

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In all three settings, we found preschool children showing interest in astronomy topics. For example, in our diary study, 69% of parents reported that they had at least one conversation about astronomy with their child during the two weeks that they participated in the study. Astronomy topics (especially the sun, the moon, the stars, and day versus night) were apparent in roughly 16% of the conversations reported to us. This was true both in middle-income highly-educated families, and also in a lower-income group of Mexican immigrant families where parents had fewer years of formal schooling. In fact, in the Mexican immigrant families, astronomy conversations constituted 19% of the conversations (Jipson, Callanan, Zumbro, & Castañeda, 2016).

These results demonstrate the importance of astronomy as part of what young children are already noticing and wondering about in their daily lives. Therefore our goal, as we designed the My Sky Tonight activities, was to build on their own natural curiosity, rather than to spark interest.

Young children’s capacity to investigate astronomy

Some might be skeptical that young children are capable of sophisticated reasoning when it comes to doing science. And yet, a significant body of research suggests that 3- to 5-year-old children are capable of scientific reasoning and problem-solving, similar to how scientists reason and investigate (e.g. Gelman et al., 2010; National Research Council, 2007). We have used this research to help us design activities that provide opportunities for young children to explore their own capacity to do science by asking scientific questions, making observations of scientific phenomena, and using evidence to make sense of their world.

Many of the My Sky Tonight activities have been designed around certain astronomical phenomena that allow children to do science through the same practices that scientists use. Using our research on children’s conversations with their families (Jipson et al., 2016), we have included events that young children already are wondering about and are part of their everyday lives: phases of the moon, the day and night cycle, and shadows cast by the sun.

The activities also were selected to allow children to extend their ability to observe from the their own backyard to phenomena that can be observed using telescopes and spacecraft, such as craters on the moon and the landscape of Mars. Through conversations with educators and parents, children are encouraged to notice new details that will help them notice patterns, make comparisons, and begin to construct scientific explanations.

We conducted a study of how the My Sky Tonight activities can provide opportunities for young children to co-construct evidence-based explanations for astronomical phenomena in museum settings (Plummer & Ricketts, 2016). We found that 3- to 5-year-old children were able to use their own observations of astronomical phenomena as evidence for claims that answered scientific questions.

The support the children received from adults during the program was key for their ability to demonstrate this sophisticated science practice. Educators and parents helped the children engage in science practices in several important ways, including by: asking questions which helped them notice key features of astronomical phenomena, providing materials that allowed them to explore the phenomena (directly, such as using flashlights to make shadows, or indirectly, such as observing photos of moon craters), and encouraging collaborative interactions with other children. We also found that attending to how children use gestures and manipulate models was important to understanding the ways they communicate their observations and explanations.

My Sky Tonight activities and the planetarium

The planetarium is an excellent way to help children make key observations of these astronomical phenomena as they explore, investigate, and make sense of their world. The My Sky Tonight activities can be used as introductions, before children come into the planetarium; as follow-up activities after a planetarium visit; or, in some cases, integrated into the children’s experience in your dome. Below, we describe some of the activities and how they can be used when children visit the planetarium.

Moon Phase Matching

The goal of the Moon Phase Matching activity is for children to begin to become more familiar with an astronomical phenomenon that interests many of them: that the moon appears to change shape and that there is a pattern to this change. The focus of the activity is a large banner showing images of the moon throughout its cycle. Children are provided with pictures of moon phases on cards and encouraged to come up to the banner, compare their cards to the images on the banner, and try to find a match.

One developmentally appropriate way to encourage children is to use process praise to focus their attention on their efforts rather than on right vs. wrong answers (e.g., “you’re working really hard to find the matching image!”). Effective use of the Moon Phase Matching activity can foster many other possible conversations around observations of the phases of the moon, as well as engage them in additional follow-up activities, such as drawing pictures of the moon in salt.

Becoming more aware of the different shapes of the moon and their change over time is the first step towards more sophisticated descriptions and explanations. We are not looking for more complex explanations of why the phases change for this young age group. Rather, it is important that they practice noticing subtle differences in objects in their world, as this is part of the skill of observation that is central to being a scientist.

Using Moon Phase Matching in the planetarium

Moon Phase Matching can be set up outside the planetarium, such as in the lobby area, for children to interact with before they enter. The activity works best if there is a docent or educator present to help facilitate the interaction; this can be very open ended with a single child or with multiple children. Partic-
participating in this activity is likely to help children be more focused on attending to what they observe and hear about the moon and its appearance in the day and night sky when they are in the planetarium.

We also recommend Moon Phase Matching as a follow-up activity to a planetarium visit, either in the museum or planetarium setting, or for a teacher to use back in the classroom. Research suggests that children learn more when provided the opportunity to build on their field trip experiences through post-visit activities (DeWitt & Storksdieck, 2008).

Bear’s Shadow

The Bear’s Shadow activity is based on the Frank Asch book *Moonbear’s Shadow*, which tells the story of a bear who is frustrated in his efforts to go fishing because his shadow scares away the fish. Throughout the day, he unsuccess-}

cessfully attempts to hide from or get rid of his shadow until finally his shadow no longer points towards the pond (because the sun is now in the opposite side of the sky).

After listening to the story, children recreate scenes from the book using a figurine to represent the bear and a flashlight to represent the sun. This activity allows children to investigate the phenomenon of shadows, as well as how the sun’s position in the sky changes the position and length of shadows throughout the day. A developmentally-appropriate strategy that is particularly useful in this activity is that of asking open-ended questions to help children construct their own explanations for how the sun’s location affects the location of bear’s shadow (e.g., “What do you notice about bear’s shadow when we shine the flashlight from over here?”).

Using Bear’s Shadow in the planetarium

The advantage of having the planetarium when teaching this activity is that you can easily demonstrate one of the central phenomena in the story: the apparent motion of the sun throughout the day. You might begin by reading the story in the planetarium, perhaps even projecting the pages of the book onto your dome for the children to more easily see. You can help children notice that the sun is low in the sky in the morning, moves slowly higher and higher throughout the day, and then moves lower again as it nears the opposite side of the sky.

We encourage the use of two strategies that help children learn about the spatial nature of the sun’s apparent motion. First, use spatial language as you ask children questions about the sun’s location in the sky. Is the sun higher or lower than it was before? Is the sun moving up or down? For young learners, using descriptive gestures as you talk can help them better understand the meaning, and, in turn, can help improve their spatial thinking (Newcombe, 2010). It is helpful to encourage children to use gestures themselves, such as using their arms to trace the path that the sun takes as it moves across the sky. This gesturing could also be used after the observation of the sun’s apparent motion as a way for children to show what they have learned. Using this type of kinesthetic movement in the planetarium has been found to help early elementary students improve their descriptions of the sun, moon, and stars’ apparent motion (Plummer, 2009).

Another way to bring this activity to the planetarium is to explore the phenomena of shadows in the dome. Provide children with flashlights and encourage them to make shadow puppets or other explorations of shadows as preliminary exploration before the more structured modeling of the bear’s shadow activity. Then, later, children can continue with the rest of the bear’s shadow materials in a workshop setting or as a post-visit activity in the classroom.

Day and Night

The Day and Night activity engages young children in exploring the differences between the day and night sky. Children compare observations of the day and night sky from photographs and are guided to the conclusion that it is the sun that is important for daytime. They then observe how a bear figure on a globe facing the sun will have daytime, while a different bear on the other side of the globe will be facing away from the sun and thus have nighttime. This leads to a discussion of the Earth’s rotation and how it allows for each bear to experience day and night. Children then stand and rotate like the Earth, facing towards and away from a lamp that
represents the sun, to model the Earth’s rotation for themselves.

Using Day and Night in the planetarium
This entire activity worked well with 3- to 5-year olds visiting the small planetarium at Pennsylvania State University. Rather than showing children photos of the day and night sky, the planetarium’s diurnal motion was used to allow the children to make observations. The next steps of the activity then can be followed as described above.
The activity write up includes images of day and night activities. Project these images onto your dome; when a daytime image is shown children should turn to face the Sun. When a nighttime image is shown, they should rotate to face away from the sun.

Conclusions
We hope that by engaging young children in astronomy activities we can extend their opportunity to explore astronomical phenomena observed in the planetarium. The planetarium is an excellent tool for helping young children learn to pay closer attention to important features of astronomical phenomena. The My Sky Tonight activities extend these observations in ways that allow for further exploration, conversation, and sense-making.

Full descriptions of these activities and associated materials can be found on our website for download: www.astrosociety.org/MySkyTonight

The activity write ups include children's ideas about astronomy found in previous research studies, questions you can ask to engage young children in these topics, and suggestions for developmentally-appropriate strategies you can use to support children during these activities.

Acknowledgments
We would like to thank planetarium educators who have participated in the My Sky Tonight professional development workshops for providing their suggestions on how the My Sky Tonight activities can be used with the planetarium (Katy Accetta, Noreen Grice, Dan Malerbo, Nathalie Martimbeau, Shira Moskowitz, Mickey Jo Sorrell, and Michele Wistisen), as well as those who contributed at the IPS 2016 workshop. My Sky Tonight is supported by the Division of Research On Learning of the National Science Foundation (AISL #1217441).

References


A question was posed on Dome-L that asked, “who has experience working with preschool-aged children in the planetarium?” My response was, not only do we have preschoolers visiting our planetarium, but we also have an actual preschool on the premises!


You’re probably wondering, what happens when preschoolers come to the Gengras Planetarium? Most of our general museum visitors tend to be families with children of ages 6 months to about 11 years, with the majority of children age 7 and under. Planetarium programs for very young children are intentionally scheduled as the first show of the day on weekdays and Saturdays, when attention spans are short and the youngest planetarium visitors might feel anxious.

Fulldome shows for this age group include Space Shapes, The Sky Over Mister Rogers’ Neighborhood, One World One Sky: Big Bird’s Adventure, and In My Backyard.

Some offerings include a live pre-show with the planetarium educator, as an introduction to the planetarium environment and to the show’s theme. The pre-show may include some kind of model and topic-related questions for the audience. Looking into the eyes of a nervous toddler while holding a prop can be quite intimidating for both the presenter and the child, so we keep the lights up and often have the inner doors open so children don’t feel trapped. We want them to feel like they are in a friendly, safe and special place.

If needed, we have three very soft and fluffy planetarium interns (stuffed animals) named Polaris, Rigel, and Arcturus who are available as sitting companions for nervous children (or adults)!

Use props when appropriate

When available and appropriate, props can be very helpful. For example, Space Shapes is a friendly introduction to the shapes of planets, the moon and our solar system. The live presenter asks, “What shape is the room?” Almost everyone replies that it is a circle. Then we show the children a baseball and ask them to identify the object. Children respond either “ball” or “baseball.” We ask “What shape is a baseball?” and almost always, the response will be “a circle.”

Then we show them a model of a pancake and ask, “What is the shape of a pancake?” and the response is usually “a circle.” Finally, the presenter holds both objects and says “In a moment, I’m going to ask you another question. Watch what happens to the ball and pancake as I count to three: 1—2—3.” Then both objects are rotated halfway.

Holding the ball and (the now edge-on view of) the pancake, we ask “What is the difference in shape between the baseball and the pancake?” Some children will immediately say “The pancake is flat,” but not always. When a child looks puzzled, we may rotate the objects again and/or hand the child the ball and the pancake for them to examine themselves. By holding and comparing the objects, many children are now able to articulate that the pancake “is skinny.” Then we transition to “Now let’s find out if objects in space are shaped like balls or pancakes or maybe even both.”

Space Shapes is also a great
show because it continues interaction with the children during the program. Ron Proctor narrates the show with such a friendly voice that when he poses questions, children verbally answer them as if Ron is in the room. This happens almost every time, whether there is one child or a classroom of children seated. At the end of the program, it’s not unusual to hear children ask, “Can we do that again? That was fun!”

Once a month, students from The Children’s Museum Preschool attend a program in the planetarium. These programs, scheduled for ages 3 to 5, start off the school year with a friendly basic introduction to the planetarium (i.e., a show like Space Shapes). As the school year progresses, other full dome or live shows are presented with advanced but age-appropriate topics. The school year ends with either an exciting trip through the solar system in a cardboard rocket (Secret of the Cardboard Rocket) or a trip to the moon with a cat named Larry (Larry Cat in Space).

In addition to preschool-aged children, visiting with their families or as students in The Children’s Museum Preschool, we also encourage outside preschool and nursery schools to visit the planetarium. Usually these teachers have prepared the students for their field trip with themed activities back at school. The teachers may also have specific requests for additional topics or demonstrations.

For some of our other programs, we offer a question and answer session at the end of the program. However, we have found that preschoolers often don’t have questions or enough background to formulate questions, but they are happy to relay to us either what they do know or what they might have observed.

In addition to planetarium programming, we have used some of the preschool activities from the Astronomical Society of the Pacific’s (ASP’s) My Sky Tonight Workshop at museum special events and as part of the Children’s Museum Preschool. These activities include themes such as Sun and Shadows, Moon Phases, Observing with Magnification, Earth’s Habitats, Solar Energy and Living and Working in Space. These activities are fun opportunities to learn astronomy concepts in a different setting.

Any planetarium educator who has not already taken a My Sky Tonight workshop may want to contact the ASP for future opportunities. (See story on page 40.)

Teaching very young children can be a bit intimidating at first, but the great thing about welcoming preschoolers is that you can help them foster an interest in science and nature at a very young age. Who knows which of them will be inspired to become a scientist, an engineer or a new planetarian!

**Interactivity Tips**

I pass out glow-in-the-dark stars, cautioning them how they are to be held, etc. We sing “Twinkle, Twinkle, Little Star,” which most know or their teacher has prepared them with. While they are singing, I gradually darken the planetarium. I have yet to have a child afraid of the dark with this introduction. I then collect all the stars.

To fully darken and bring up the stars, I have the children get on their knees to reach up and try to “catch” a star on their hands. This also helps the children understand that the stars are not real.

I use glow-in-the-dark string tied into loops, not terribly big. The loops are passed out and we talk about shapes, mainly ones they already know like square and triangle. Dim the lights and have the children lift their “squares.” We look for squares in the sky, with stars at the corners. Then we repeat the process with triangles. (Sometimes we just do triangles because they are easy to make and find.)

I use a black light inside a box with a cover to “charge” the glow-in-the-dark materials. Sometimes I introduce constellations using small stuffed animals, objects, and/or “people” I have collected over the years. I explain that they are models of the real thing, like our planetarium is a model. I introduce the models using a red flashlight in the dark and pass them out. It’s OK if you don’t have enough; many will get a chance to hold a model. Then I point out a constellation, giving clues to its identity. I invite the person who is holding that model to raise it up over their head. If they can’t, then open it up to the rest of the children. Somebody will know and that person gets the model for a while. (This doesn’t work for large groups.) When I return, I’m amazed at how many times the older children want to do this!

Dayle Brown
South Bend, Indiana USA

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**Meet the Solar System combines hands-on activity, art, and learning**

The Maryland Science Center’s (MSC) Davis Planetarium presents a program for homeschool students aged 4-7 years called Meet the Solar System.

The program features crayon interpretations of the sun, moon, planets, and the dwarf planet Pluto. Presented live, Meet the Solar System is a tour/review of primary objects in our solar system and an opportunity for young students to practice saying each object’s name and learning what makes it special.

After a group effort countdown and launch from an imaginary, crayon-drawn launch site, our crayon-created rocket zips and zooms from world to world and concludes at the sun.

Students are then invited to draw a crayon world (on a paper plate) of their own to take home—but not before they have a chance to tell the planetarium staff all about it.

Meet the Solar System debuted for MSC’s homeschool weeks in October 2014. It has since been offered during subsequent homeschool weeks in January and September. Well received and well attended, development of the program continues as we introduce additional crayon-drawn elements such as asteroids and comets.

For those curious, the Davis Planetarium’s Meet the Solar System is programmed with Sky-Skan’s Definiti fulldome projection system.

Wendy Ackerman, Maryland Science Center
Baltimore, Maryland USA
You can have 0-3 years under your dome without a meltdown

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The Lake Erie Nature & Science Center has had a long-standing tradition of providing programming for preschoolers and toddlers. Our ever-popular show, Twinkle Tots, began 20 years ago. During my few years here at the Schuele Planetarium, we were running into the problem of our 0- to-3-year-old crowd simply not enjoying the planetarium, and yet parents insisting on bringing these youngsters into the dome. Recently we worked with our resident preschool expert, Teece Lester, to work out a better program. Our solution is elegant and simple, and it really works.

We started with what we knew: we wanted very young children to enjoy our planetarium and want to come back. As commonly understood from a child psychological point of view, our preschool teachers told us that before the age of 7 years old, children cannot understand abstract ideas. Nor can they understand time, space, or distance. This was a problem due to the old way our Twinkle Tots show was being presented. In the old show, we had been discussing constellations and abstract pictures with 3-year olds, and they could not understand why they could not go outside and see an actual lion in the nighttime sky.

We also were plunging the audience into darkness without warning or control and the children were getting very scared. The children were not understanding the simple concept of looking up, and we were not telling them that was what they needed to do in order to have fun. With these realizations, we decided to reassess our goals for the show.

Our new goals for the Twinkle Tots show became very simple:
- To get children used to light and dark
- To expose children to day and night
- To understand the sun is a star
- To examine the moon as a sphere (ball)
- To realize the stars shine night and day
With these goals in mind, we developed a 15- to 20-minute show that always touches on at least three of our goals at a time.

Same program, small changes
Our new show follows the same format every time with minor weekly changes. We begin with a white dome. When the audience enters it is very bright and friendly, and there is always fun children’s music playing in the background. After everyone has entered the room, we close the doors and dim the side lights. Following introductions and explanation of the rules, we simply have everyone look up. Children do not always look up naturally, so in the planetarium, they must be told to look up at the ceiling. Sometimes this step alone is surprising for our young visitors. Since all of the lights have remained on, there usually is no crying at this point.

We do tell the children that our ceiling is “magic,” and that it can change to any color they want (thanks to our ChromaCove lighting system). We take requests for colors that they would like to see. Once we decide on a color, everyone must raise their hands in the air, wave them around, and shout out the color. This action gives the children control of their environment. If children do not have control of a new environment, they can get scared very quickly.

Once the dome changes colors, as a group we try to think of other objects in our daily lives that are the same color. Some of the answers from children are absolutely hilarious. Our last color is blue because it resembles the daytime sky and it gives us the chance to talk about what we see in the sky in the daytime and nighttime.

Once we get on the subject of nighttime, it is time to dim the lights so we can see the stars. We give the audience complete charge over this process, however, allowing the children to take “control” of the dark. We ask the kids to reach up to the sky, grab some blue light, and pull it down to put it in their pockets for later, and as they do this we fade down the blue light to full dark. Soon, everyone is reaching for the sky and pulling themselves into darkness. We occasionally get a few nervous cries from children that have never done this before, but they are usually gone by the time that they realize there aren’t any stars.

By creating a false “emergency,” the fact that there are no stars in the sky, the kids quickly wonder where the stars have gone. The presenter claims the stars are hiding, and that we need to sing the stars’ favorite song in order to get them to come out and dance.
Every single audience member usually joins in on the singing of “Twinkle, Twinkle Little Star” as we slowly fade in the stars. After clapping and cheering, the stars dance for us, using the ChromaCove programming synchronized to music and daily motion of the stars. We use different music weekly, to keep things interesting.

Following the light show, we blast off to a different object in our solar system to get a closer look at it and to learn a basic fact about it. For instance, when we blast off to the moon, we learn it is round like a ball, and we can only see the sunny parts, which is why it looks like it changes shape. Short, simple, to the point, we learn it is round like a ball, and we can only see the sunny parts, which is why it looks like it changes shape. Short, simple, to the point, and ever changing.

Time to enjoy the stars

Following the fun, we play some calm space-related music, have daily motion moving, and sit in total darkness for about 3 minutes. If anyone starts to get fussy, we introduce “Superman” and “Tinkerbell,” our red and green lasers. The lasers dance between the stars and trace out the constellations as they pass by, but nothing is spoken. We truly believe that the lesson teaches itself. The dancing lasers distract the children from what they are afraid of, and our presenters have come up with some impressive choreography for certain songs.

Using the dome lights to reinforce and teach

Before we purchased One World, One Sky: Big Bird’s Adventure, I would always do a live program with our pre-K guests. Our planetarium has a nice large open space in the front, where I gather preschoolers around in a semi-circle and have them sit on the floor. I have cloth squares to help them know where to sit.

I sit in front of them on the floor and we go through multiple activities, some hands-on and some with the dome. As I’m able to control the planetarium (cove lights and projectors) with an iPad, we explore concepts such as color, shapes, hot vs. cold, stars, planets, the sun, and the moon.

I have reflection/absorption activities that I use with the dome lights that make faces change from sad to angry. The sad face shows up under blue light, the angry face shows up under red—so we talk about emotions and color, i.e. how sometimes you feel “blue” when sad, or get red when angry. We also have a visual that has a cat and a face. Under a certain color, the cat disappears and the face turns from happy to sad (because they lost their cat).

I do the general daytime sky vs nighttime sky. We have a nice rainbow we can put up and we talk about weather a bit. When we go to nighttime, it gets really dark and I ask them what we could use to help us see. We can use flash lights, lamps … but what if the power is out and you don’t have batteries? Candles. I put up a big image of a candle all around the dome, so they are surrounded by candles, which helps us see each other better. Again, we talk about hot/cold and how they are hot but the sun and other stars are hotter. They then can help me “blow out” the candles. It’s a lot of fun.

I put up all the constellation pictures and we find different animals/people/objects. I try to get them to use words and phrases like “up/down, left/right, above/below, next to...” We can try animal noises too.

We have had parents declare “I don’t think my kid will enjoy this but we will give it a try” at the start of the show, and then everyone walks out with huge smiles on their faces and kids jumping up and down screaming, “That was awesome!”

Our favorite success story was one of a child who was completely afraid to enter the planetarium because he was afraid of the dark. His mother convinced him to come in the doors, with the agreement that she would stand with him right at the back of the room, and they would leave as soon as it got scary. When the dome changed to his favorite color, his face lit up with excitement, and he was completely involved for the rest of the show. His mother called us miracle workers, since up the then she had been unable to get him to be in the dark for longer than 2 minutes.

Since our program rewrite in September of 2015, we have seen many positives. There has been an increase in attendance to the program itself, more positive feedback, and kids are really enjoying themselves under our dome.

An unintended outcome quickly became apparent, however. Kids are enjoying themselves so much that they have stopped crying when they enter the planetarium, but they are now crying because the show is over! We have had parents declare “I don’t think I will be able to watch with my 2-year old crying because the planetarium show ended and they must leave.”

Our formula of less is more and let the lesson teach itself has become a huge success under our dome.
Quick! What do you think when you hear “Education”? If you’re like many people, you thought “school.” But, of course, people are always learning, no matter their age and regardless of whether they’re being graded. All that out-of-school, life-long learning is the reason for the term “informal education.” Since 2002, JPL’s Informal Education group has run NASA’s Museum Alliance, providing museums and other informal education institutions with access to NASA staff, resources, and professional development.

Membership is free, and opens all of the Alliance’s resources to users. Just go to informal.jpl.nasa.gov/museum and sign up.

More than 700 organizations around the world—not just museums, but also planetariums, science centers, libraries, parks, observatories, camps, nature centers, and youth-serving organizations—are Museum Alliance members. They in turn share those NASA resources with their own audiences, through exhibitions and programming.

The historic flyby of Pluto illustrates the impact of this approach. Museum Alliance members were kept up to date on the mission and image-release timeline, received New Horizons giveaways for their visitors, were able to speak directly with mission scientists, received training on related hands-on activities, and were given all the latest links, social media resources and downloadable graphics.

They helped people learn when no one “had to” learn anything, and not just about Pluto. Every day, Museum Alliance members build on the intrinsically inspiring work of NASA in order to encourage people’s natural drive to know more, a drive that is itself at the heart of NASA’s mission.

Apply for a grant
The agency’s Competitive Program for Science Museums, Planetariums, and NASA Visitor Centers (informal.jpl.nasa.gov/museum/CP4SMP) provides funding in support of NASA-related content. (Check out the Map of Awardees on the site to see what NASA content might be in a museum near you.)

The Children’s Museum of Indianapolis, Indiana, for instance, just opened its International Space Station exhibit, Beyond Spaceship Earth, (www.childrensmuseum.org/exhibits/beyond-spaceship-earth) and lets visitors see what its like to be an astronaut. Can’t make it to the museum? There’s an app for that! www.childrensmuseum.org/exhibits/beyond-spaceship-earth/app

(Also check page 90 of this issue to read about an award to the Museum of Science in Boston, Massachusetts.)

Eclipse 2017 resources
The Museum Alliance has made a special resource section for the 2017 total solar eclipse available to all viewers. Although the free membership is required for full access to the Museum Alliance site, the eclipse resource section is open to all. informal.jpl.nasa.gov/museum/content/eclipse-2017

Virtual reality for planetarium shows
NASA has been releasing various media on 360 VR format, which can be directly used by digital planetariums. The Museum Alliance is hosting downloadable 360 videos and images which can be projected as a sphere inside your dome for the full VR effect.

A sample script for Sky-Skan’s Digital Sky 2 system is included, but the media is able to be used by several other systems. Take your audiences flying inside the Juno spacecraft, training underwater with astronauts, or standing on the dunes of Mars with Curiosity today! https://informal.jpl.nasa.gov/museum/content/jpl-virtual-reality-planetarium-show

Professional development
In addition to all this wonderful free stuff, the Museum Alliance’s primary product is professional development teleconferences with NASA scientists and other experts. These teleconferences are literally as easy as a phone call. Your planetarium presenters and other staff get to hear from and ask questions of our scientists directly.

In other words, the people on the front lines of teaching space science get to interact with the people on the front lines of doing space science. That way, planetarium presenters can stay up to date on the latest in NASA. Also, by talking with NASA researchers, our hope is that they will take NASA science, and turn it into their own, personal NASA story, which they can use to engage their audiences.

I (Jeff) know that, when I was first starting off as a planetarium presenter, I would have loved the opportunity to talk with the scientists and engineers who are working on the subjects that I was teaching in my dome. At the very least, I would have asked them the questions from my audiences that always stumped me.

Even today, after more than a decade of teaching in a planetarium, I still learn something new and worthwhile in each telecon, from Earth science, to the solar system, and beyond. That’s what NASA is all about, after all: learning and doing things that are new and worthwhile to everyone.

Amelia Chapman has more than 20 years of experience as an informal educator. Working in a range of science, history, art and cultural museums, she has helped audiences of all ages learn from real objects and direct, hands-on experiences. Now at NASA’s Jet Propulsion Laboratory, she helps run the Museum Alliance community of practice, providing professional development and NASA resources to informal educators who want to use the excitement of space exploration and scientific discovery to inspire new generations.

A chemist by education, Jeff Nee started as a student presenter at the William K. Holt planetarium in the Lawrence Hall of Science in Berkeley, California. Teaching there for more than 10 years, under the tutelage of Alan Gould and Toshi Komatsu, Jeff learned, first hand, the immeasurable impact an immersive, engaging dome can have on student learning. This past year, he joined the Museum Alliance team under Anita Sohus. He is continuing to advocate and create resources for planetarium education, this time on the global scale of NASA’s Museum Alliance.
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By Ronald Walker

Over a half century ago I had my first encounter with a planetarium. That first visit on a young lad growing up in Chicago left an impression that has lasted a lifetime. Actually, it was a two pronged impression. First, there can’t be that many stars (remember I grew up in Chicago), or could there? This was something to look into. Second, the machine in the center of the room was right out of an H.G. Wells novel. My imagination and interest took off and haven’t stopped since.

For me the digital revolution was a godsend. A lot of facilities were replacing very useable optical/mechanical projectors with new video systems and I was very lucky to get one. As an "amateur planetarian" I never expected to be able to build, let alone operate, what I would call a “museum-level dome,” but after two years of building and wiring, my crowning achievement was complete: a 30-ft. (9.1-m) dome with a Minolta/Viewlex IIB projector.

Missing: An audience

It was fantastic, at least for the first week or two, then I realized something was missing: an audience. For those of you who can remember the Unitron ad on the back cover of Sky & Telescope, it often contained the old English proverb, “A joy shared is a joy doubled.” That was the answer. For my little project to succeed, it needed more visitors, others to share my joy.

Suddenly I realized that even though I was at the bottom of the hierarchy of the planetarium community, I had exactly the same problem even the biggest domes had: how to get people to come to the shows. I have heard it said that most people visit a planetarium twice in their lifetime, once when their parents take them and then once when they take their kids. So how does one get people to visit?

I must admit that I suddenly had misgivings about what I had done—perhaps there was more to the digital revolution then I thought. Unfortunately, the cost of even the cheapest digital fulldome projectors was more then I had spent for my entire project so far. And then add the programming costs on top of that? No, that direction was closed to me.

I did notice a unique direction that others were taking, basically, a standard flat screen theater with a computer-controlled image that could be manipulated in real time, basically a planetarium without the dome. But in my mind, a dome was the variable that turned a theater into a planetarium. No, I had a dome and a really good night sky, so any video additions were more for special effects. I could project out a normal flat video image, the front window of my personal “spaceship of the imagination,” and take the viewer where my optical-mechanical projector couldn’t go. But then the computers tended to present me with “the blue screen of death” more often then not, so perhaps I should stick with what worked and could be understood by me, i.e. 1970’s technology.

Much experimentation is in order with both fisheye and mirror dome projection which can add a new dimension to presentations. I just wish front surface dome mirrors weren’t so expensive; that direction will have to wait.

Wait—why not ask the visitors?

These are things that could possibly put people in seats, but for how long? Time to rip out my hair and just give up. Then it hit me: why not ask visitors what they would like? To my surprise, when asked the direct question, most were very happy with what I was providing. The younger set were somewhat in awe, as many had not seen the raw night sky, even in other planetariums. Perhaps I was trying to do too much in my shows; perhaps the viewers didn’t want more information, but were happy with less.

Research uncovered planetariums that had showed a single show, day in and day out, for decades, with sell-out audiences for each show. Being in a tourist area certainly helped, as there is a constant flow of new viewers every day. Others offer a multiple of shows every day, changing each and every hour, and finally others offer a new show that runs daily for several months before changing.

It occurred to me that perhaps a combination of the three ideas might work and it was certainly worth a try. My experiment has shows given on three weekends each month. The first has an introduction to the planetarium and the night sky, my answer to the show that repeats continuously. The second has a show that repeats every year on a given month.
Eastern Patagonia is a region in Argentina well known to the Welsh and whales. The former colonized these lands over 150 years ago, and the latter arrive to its shores every winter to the delight of worldwide visitors.

Trelew is a city of over 100,000 sitting about 15 miles inland from the nearest shore, and less than 100 miles from the whale sanctuary in Peninsula Valdés. The city gained much fame in 2014 when researchers at the Museum of Paleontology Egidio Feruglio announced that fossils found three years earlier belonged to the largest dinosaur ever discovered: a massive 76-ton, 130-foot long titanosaur. This is no mere coincidence: Patagonia has been known to be a paleontological paradise since Darwin’s travels, and today it still provides us with eye-opening findings.

This is the context. Now, for all its natural wonders, it is amazing that astronomy has been slow to come this far south, especially if you take the trouble to look up. In winter, the Milky Way hangs above your head, spreading its bright arms away from Sagittarius as in a giant embrace of Earth. Then, when the weather gets warmer, the Magellan Clouds rise higher and are wonder to see. And you do not need to climb a mountain or to travel far to see a nearly light-free sky.

Consider this: The province of Chubut, location of Trelew, is as big as Minnesota but its entire population matches that of Albany (New York), or about 6 people per square mile, most of whom live in cities.

The lack of astronomers this far south is possibly due to the fact that Patagonia was quite isolated from the rest of the country for many years. Until 1865, central Patagonia was inhabited by the Tehuelches and other aboriginal groups. First settlers, mainly from Wales, coexisted peacefully with the Tehuelches and devoted themselves to farming and trading.

Then with newer (and not so peaceful) immigration waves from the north, large sheep farms became more common. Later on, new industries began to grow: oil, mining, fisheries, etc. Thus, scientific development followed the path of these industries: geology, palaeontology, marine biology, and so on.

Observatories were mainly established farther north and west. As far as I know, the first astronomer to do related work here is Néstor Camino, who obtained his astronomy degree from La Plata University. More than 30 years ago, he found a home in Esquel, a small city by the Andes mountains, and there he did much outreach and educational work to bring the night sky to local schools and children. If you ever go that way, do hunt for Esquel’s hidden treasures: several large, artistic, and accurate sundials.

Born in the 1990s

The Trelew planetarium (as it was called back then) was born as a project back in the late 1990s, when the then Mayor Gustavo Di Benedeto (recently deceased) envisioned it as a way to promote evening activities in the region. The building was planned with advice from La Plata Observatory personnel,
but construction stopped with Argentina’s economical and political turmoil of 2001-2002. Because over 75% of the facility was already built, the new authorities decided to finish it in 2007, but after that it went into a sort of limbo.

In 2012, a different story began. A group of friends who share the passion for astronomy met at some of the astronomy talks I used to give at the Palaeontology Museum (where I worked as outreach coordinator for almost 10 years). After some time, these amigos created the Foundation “Friends of Astronomy” (FFA), under the leadership of Dr. Vito Saraniti, a well-known local medical doctor who specializes in imaging diagnostics. And quietly as well, they began their own attempt at using the planetarium as intended, enlisting me as a collaborator.

Star parties, talks, and workshops gave occasional life to the building. Finally, early this year, an agreement with the City of Trelew, now headed by Mayor Adrián Maderna, was formalized, giving management of the facilities to the FFA for the next 3 years, so that astronomy-related activities could be carried out.

And a new story begins

Let me first describe what we have. The building stands on a low hill overlooking a small lake called Laguna Chiquichano, some 10 blocks from downtown Trelew, and within walking distance from the long-distance bus terminal.

The building’s lower floor has the city radio’s station in one wing and a 50-seat auditorium in the other. Across from the auditorium, there is the cafeteria (not formally opened yet), where we have delivered a few Astro Café events. Finally, in the ample lower hall, we shall have our main astronomical exhibitions.

On the upper floor, right above the radio station, we have the planetarium room itself with an 8-m dome. However, as of this writing, we have only a basic system (spherical mirror), and no projection screen. For the time being we are using an inflatable dome. The planetarium is flanked by the city’s tourism bureau and the FFA administrative office.

In the other wing are two observatory rooms. The larger one is prepared to have a 3-m conventional dome, and the other one does have a usable sliding roof. Next to them, there is also a 60 m² room which we plan to use as a lab for practical activities and demonstrations, and/or smaller interactive exhibitions. Linking all these rooms together, there are halls on each floor which we plan to use as exhibition space.

The surrounding outdoor area is ample enough for development of a theme park, and a few (very few!) resources are there already. Even though we have a great view of the sky, it is not free from light pollution. However, this is not terribly bad: on a good night, a pale Milky Way still can be seen across the city sky.

In a way, original planners favoured having a well-located, easily accessible facility over a darker site. I believe this was a sound decision. We will, in time, draw a plan to soften the impact of nearby lighting, and we can also organize star parties in other nearby sites, and drive distance from downtown Trelew.

On such premises, we are setting to work. As we have so few resources, we have been focusing on activities for local schools and families, such as workshops, talks, and observing nights. These activities are aimed to regenerate local interest in this project. This has been a key point as people need to discover that the planetarium is finally, even if partially, operating.

February’s solar eclipse

In February 2017 there will be an annular eclipse visible throughout Patagonia. In our region, the annular visibility band will pass throughout the southern edge of the province of Chubut, across many nearby desert fields. In fact, the only city within that band is Camarones, a town of 1,500 on the Atlantic shore, and about 100 miles south of Trelew.

Thus, we are organizing a public 2-city event: first, pre-eclipse in Trelew (Friday and Saturday), with talks, workshops and activities for the general public, and then the eclipse watch on Sunday. We shall go to Camarones, but we hope to have some volunteers to show the eclipse from Trelew as well.

The plan we agreed on with the local authorities include an observing session from a beautiful site by the beach (with a camping ground across the street), and a regional fair (local folk offering handmade products and such). We deemed important to have an alternative attraction for those travelling from other cities and, especially, in case of a cloudy/rainy sky.

Finally...

After so many years, we are happy to see the Trelew Astronomy Center flourish. Throughout all these years, I had been fortunate enough to be an IPS member. And I owe a big thanks to everyone, but especially to my friends Dale Smith, Susan Button, and Sharon Shanks. They have had a lot of faith in the development of planetariums in Argentina (and throughout South America as well), and were a constant support on demand.

I hope the broader planetarium community will get in touch and help us keep moving on. And, if you come to Patagonia, just let me know. We’ll go out and embrace the Milky Way back.

Pedro Saizar is an astronomer (PhD from The Ohio State University). He is currently coordinating the science and education activities at the Trelew Astronomy Center. He also teaches physics at a teacher-training college in Trelew. Until last year, he was outreach coordinator at the Museum of Paleontology Egidio Feruglio.

Interested Trelew residents take part in an astronomy lecture inside the center (top), and use telescopes outside. Photos provided by author.
More than 250 people in the theater held their breath as we awaited the response...when Astronaut Jeff Williams’ voice came over the line, the excitement was palpable. While Williams was orbiting the Earth onboard the International Space Station (ISS), he took time out of his dinner to answer questions from 15 children at the Peoria Riverfront Museum. This fantastic opportunity was due to the Amateur Radio on the International Space Station (ARISS) program, and any school or educational organization can apply for a scheduled contact!

An international consortium of amateur radio organizations and the space agencies of the USA, Russia, Canada, Japan, and Europe manage the program. The goals of ARISS are to inspire an interest in science, technology, engineering, and math subjects and related careers in young people, and to raise awareness about space exploration, satellite communications, and wireless technologies.

Since 2001 there have been more than 1000 successful contacts from the ISS to organizations all over the world. Calls can either be direct contacts, in which amateur radio enthusiasts help set up a ham radio set at your institution to call the ISS as it passes overhead, or telebridge contacts, where a dedicated ARISS amateur radio ground station establishes the radio link with the ISS. Voice communications between students and the astronaut are then patched.
over regular telephone lines. With each method, the call is usually only 10-15 minutes, as the ISS is traveling so fast that it gets from horizon to horizon in about that time.

**Good share from a colleague**

I heard about this program from a talk by Mitch Lumen (Evansville Museum of Arts, History and Science, Indiana) at GLPA 2014. Like many great concepts discussed at conferences, I kept the idea in the back of my mind until the time was right. The time was this summer, when the Peoria Riverfront Museum's feature exhibition was “Be the Astronaut.”

ARISS accepts applications from September to November each year. After contacting and partnering with the Peoria Area Amateur Radio Club and the University of Illinois Extension 4-H, I submitted our application. We found out in February that we were one of 17 sites selected for the year.

Participation in ARISS is free. Applicants must submit an education plan showing how they will teach about the science done on the ISS, wireless technology, the electromagnetic spectrum, and other related topics. ARISS also wants to know how applicants will advertise the event, and what technology they will use. Find all the information needed to apply on the ARISS website: www.ariss.org/apply-to-host-an-ariss-contact.html

**Education plan underway**

In the months leading up to the call, we started carrying out our education plan—adding displays in the museum about the ISS and the electromagnetic spectrum, teaching about the ISS in the planetarium, and putting on a class with the partners about the ISS and radio technology. The students in our class got to ask the questions on the live call.

While planning for the contact, we soon learned we would not be able to do a direct contact. Tall buildings surrounding the museum blocked too much signal. A telebridge call was simple—we called a conferencing line over our voice-over-IP phone system. Museum staff practiced the technology set up several times before the day of the call, noting which sound, lighting, and display options worked the best.

ARISS is not able to give participants a final date and time for the call until the week before. When we finally learned the exact date, our marketing kicked into high gear. The week leading up to the call was a whirlwind of making radio and TV appearances, finishing last minute details, and testing the technology one last time.

We must have been successful in getting the word out, as more than 350 people showed up for the event! Of that, 200 were seated in the theater, another 50 were sitting in aisles, and 100 people were seated in a smaller room elsewhere in the museum, watching the live broadcast we were streaming on YouTube and Google Plus.

Before the call, the Peoria Amateur Radio Club gave a short talk, and I presented about the science being done on the ISS. After connecting to the conferencing phone line, we were connected to the space station. Williams’ voice came over the line loud and clear. He was funny and gracious as he answered the children’s questions. You can watch our recording of the experience here: www.youtube.com/watch?v=7XQaWbFGQ2c

Our visitors reacted very positively to the event. Many stopped to thank museum staff for bringing the program to the area and making the event free. Putting on the event did require quite a bit of work and time, planning the logistics, talking to media, coordinating technology, and working with our partners. The work was well worth it to see the excitement as people left the museum that day.

The 15 children who asked the questions were over the moon that they got to speak with an astronaut in space! Not only was the event fantastic from a mission perspective—we showed 350 people how exciting and fun space and technology are—but it also helped advertise the museum and planetarium to a large audience.

Apply for an ARISS contact. Your institution has nothing to lose and much to gain. ✪
The immersive technology revolution is upon us. The proliferation of VR devices, everything from the impressive HTC Vive to devices as simple as Google Cardboard, creates a new market for the immersive content that the planetarium community produces. As you are all aware, our entire field is currently exploring ways to leverage this new market.

One solution is to use these devices to broaden and extend the reach of the planetarium show. Imagine a future when a live presentation at your planetarium is not only being viewed by those inside your dome, but also by people in their homes, on their own VR devices, and potentially all around the world.

On October 28, The Adler Planetarium hosted its third Kavli Fulldome Lecture. This domecast lecture series has evolved a growing network (to date around 30) planetariums in North and South America, Europe, and Africa. In the future we hope to accommodate more time zones, enabling Asia and Australia to participate as well.

A significant amount of effort goes into creating the high quality original visualization content for this lecture series. The audience that can fit in our dome (200) makes it hard to justify that level of effort, both to our institution and the sponsors (the Kavli Foundation). Using the domecasting abilities of Uniview changes the equation; we can now reach dozens of planetariums and audiences of thousands with a single lecture.

How can we take this further, so that a single lecture reaches tens or hundreds of thousands of viewers? This is what we are hoping to achieve through VRcasting.

**VRcasting**

The third Kavli Fulldome lecture featured Nergis Mavalvala from MIT speaking on “The Warped Universe: The 100-Year Quest to Detect Gravitational Waves.” In addition to the domecast connections, we streamed a full-sphere 360-degree view to YouTube 360. Anyone on the internet could watch through their VR headsets (of even just on the computer).

VRcasting has the potential to break down geographic barriers. People in areas of the world without planetariums (such as much of Africa) will be able to participate. VRcasting can also break down mobility barriers. People in our own community of Chicago could view this lecture from their hospital beds.

This first experiment in live 360 streaming from the planetarium was quite successful. For the next Kavli Fulldome Lecture (in Spring 2017) we plan to involve a much larger audience.

**Pixel streaming and the Tower of Babel**

The YouTube 360 feeds could be used by other planetariums as well, expanding the potential domecast network. Domecasting works in much the way as an online multiplayer game works. Each dome is running the same software and is loaded with the same content; they simply synchronize configuration information over the internet. This solution is elegant and requires far less bandwidth than streaming video.

But it also requires both the domecaster and the domecastee to be running the same software (in our case Uniview), which means that domecasts are limited in the number of domes they can involve. This is the “Tower of Babel” problem that limits collaboration in our field.

Streaming pixels can get around this limitation. A planetarium running another vendor’s software could pull in the YouTube 360 stream and display it on their dome. The issue now is resolution: we

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1 See more about the Kavli Institute of Cosmological Physics at the University of Chicago at cfcp.uchicago.edu/index.php; for more about the lecture, go to http://www.adlerplanetarium.org/events/warped-universe-100-year-quest-detect-gravitational-waves-10-28-16-2016-10-28/
On October 7 during the GSCA Digital Dome Demo at Ontario Science Centre, E&S and Christie Digital made history. We presented the world’s first True8K™ digital system in a giant screen dome theater.

This system is designed to surpass the image quality of 1570 film with all the digital astronomy power of Digistar 6.

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In my last column, I mentioned judging science videos for the Jackson Hole WILD Festival. I normally judge in the Earth and Space Science category, but did not judge in the immersive category this year because of the possibility that a video I worked on would be entered. More than 400 videos were submitted to the festival and I was responsible for viewing and judging about 36 of them in my category.

The winning films across all categories in the Science Media Awards were awarded at the Summit in the Hub (SMASH) in Boston, held in September by Jackson Hole WILD. You can see a list of winners at www.sciencemediasummit.org/2016-media-competition.html.

The “Immersive: Fulldome, 3D and Large Format” category was won by David Attenborough’s Conquest of the Skies 3D.

Runners up were Asteroid: Mission Extreme from National Geographic and Sky-Skan, and From Dream to Discovery by the Hayden Planetarium/Museum of Science in Boston. Sky-Skan also sponsored the “Earth & Sky” category.

Judging for the festival wasn’t my first rodeo with them, or with judging at festivals in general. It’s always a learning experience, and at best, I get to learn lessons about production from the winners whose films I’ve watched. This year was no different, and I tallied some interesting observations as I watched my assigned videos. They’re things that we as fulldome producers can and should consider as we do our work.

Science content matters

The most important thing to remember for those of us creating science content is that accuracy matters. We all strive to write the most accurate scripts we can, but all that hard work can easily be undone by problems in production. For example, several times at festivals, I’ve seen shows that were hindered by incorrect visualizations, poor translations, and sometimes incomprehensible narrators.

No matter how well the script was written, if the animator creates a scene that is scientifically incorrect or a narrator continually mispronounces words or rushes the narration, accuracy is affected. The audience is left with a poor idea of what the show is trying to convey. I’m sure that everyone reading this has seen such errors in Hollywood movies, but they happen in our own fulldome community as well.

It’s understandable. Production is a complex and lengthy process. However, there’s always time to do it right. That means, at the outset, use reviewers for your script. Pay them to help you make it better. I know many producers do this, and I’ve even assisted a few as a reviewer. As a scriptwriter myself, I welcome the review process. It’s important because I don’t see my work the same way a “fresh” set of eyes will perceive it.

Some years ago, when I was an editor and writer at Sky & Telescope magazine, every article I worked on passed by three different sets of eyes. We did it every month, on deadline, without fail. We were fanatic about getting it right. I also did the same thing with my last book; I found about two dozen reviewers to go over the chapters and find any problems or mistakes. It was the best investment I ever made. So, embrace reviewers (and reward them). They will help keep the production honest.

Some productions might have at least one or two reviewers. This is true of all the shows I’ve produced over the years. Some productions involve entire advisory committees. Among others, Adler Planetarium, the American Museum of Natural History, the California Academy of Sciences, and NSC Creative have all incorporated teams of science advisors in their productions. More reviewers offer more insight into how to incorporate opinions from a diverse set of stakeholders. Working with review teams and curatorial committees requires a level of engagement different from working with individual reviewers, but either way, the results can be worth it.

Avoid hype

Science subject matter, especially in astronomy, is already pretty interesting—it really doesn’t require hyping or overstating. It needs a writer who can convey the wonder of the subject without going over the top in the narrative. This is particularly true if there are visualizations that provide dramatic interest on their own. A hyped-up script shouted by a narrator just exacerbates hype. This is an area where reviewers can and should help tone things down a bit.

Use your narrator wisely

Speaking of narrators, it’s really, really, really important to direct your narrator. No matter who it is or how big a star they are, even the most experienced actors benefit from (and usually expect) some direction. I can often tell when a narrator is not directed in a show. Lack of direction hurts the production.

Narrators are literally the voice of the show. They are storytellers. That means the script is a storytelling device, not a novel or a textbook. And, if a producer wants it to sound a certain way, he or she has to direct them.

Directing a narrator is also important in terms of pronunciation and cadence. One show that I judged for the festival was narrated by a person who did not speak English as a primary language, yet it was...
produced for a mainly English-speaking audience. A number of the science terms were so badly mispronounced that it was laughable. The narrator's speaking cadence did not fit English, and it made some sentences nearly unintelligible. Imagine how the audience must have “tuned out” during that performance!

In another show, the narrator was over-the-top excited about the topic, and the performance overshadowed the truly amazing footage and science story. Such problems could have been smoothed out with narration direction.

The same solution applies to already-produced shows. It's important to remember these issues when working with fulldome producers from other countries as they bring their existing shows to English-speaking audiences. It also holds true when converting English shows to other languages. Along with a correct translation, directing replacement narrations is important.

Also, consider doing a “scratch” narration (yourself, or bringing in a “stand-in” to narrate it for you before going to the final narrator.) It helps the production team understand how the words will sound and how they will time out with the visuals. Mated with a pre-render or preliminary renders, the stand-in narration gives a good idea of what needs to be tweaked in the scene and the script.

Reviewing visualizations, scenes, and choreography

Once you get into production, the storyboarding process is where producers weed out errors in visualization. A reviewer or two can provide valuable input; they may find out that the moon is too big in the sky or an orbital motion is depicted incorrectly, for example. It's the point where a pre-viz animation can show if a sequence is going to work or not. It's also the best time to “re-do” work to correct errors. That's important because not fixing the problems simply undermines the whole point of creating exciting science content in the first place.

Other methods of review

Test audiences come in handy during the production process, too. Consider using them when you can. For what it's worth, the entire procedure of checking your work is heavily enforced in NSF grant-produced work, usually with multiple layers of review. In those cases, producers are also reviewing for audience comprehension and other factors.

I can't say enough about reviewing as a production progresses. Many producers know this innately, but it's not a bad idea to reinforce the concept.

So, the general message here is simple: Science accuracy matters in fulldome shows. We all know this. We all work hard to maintain it. The way to keep accuracy up front is to review, review, and review some more. Good reviewers or science advisors can catch mistakes in early stages. They should review the script, visuals, storyboards, even the mid-point renders.

We are very lucky in the fulldome community to have a treasure trove of people who can help a producer avoid mistakes in science explanation and errors in production that affect the accuracy of a show. Just ask any of us who have produced shows: we've been there and done that and probably made all the mistakes at least once. Many of us who have advised on fulldome shows as part of our jobs or as consultants know that the results are worth the time and effort. The multiple pairs of eyes a producer engages early on will be a lifesaver in a production.

IMERSA and GSCA Dome Day in Toronto

The IMERSA team was in Toronto in October, to see the “World’s First True8K™ Digital Fulldome Demonstration” presented by the Giant Screen Cinema Association (GSCA, giantscreencinema.com) Technical Committee. Board member Dan Neafus shared his thoughts on the event.

Evans & Sutherland (es.com) and Christie® Digital (christiedigital.com) provided 10 Christie Mirage 304K projectors, demonstrating a viable alternative to film-based projection. The spectacular presentation compared IMAX film side-by-side with fulldome video in the Ontario Science Center’s 24-meter dome.

“We were pleased to join forces once again with Christie at the GSCA and, this year, to showcase our new Digistar 6 system with True8K resolution,” said Michael Daut, creative director and marketing director, Evans & Sutherland Digital Theater. “This demo reset the bar and established a new gold standard for image quality and maximum immersive impact. It’s humbling and exciting to be making history with this first of its kind demonstration.”

The fulldome system projected 8K resolution content across every meridian of the dome and the side-by-side 15/70 film versus 8K digital display allowed attendees to compare the quality of both. Numerous elements were created specifically for this event by giant screen filmmakers from around the world.

Great care was taken to show the most pristine image sources: 15/70 film was printed from the original camera negative; original camera footage in 8K was carefully mastered and color timed in full 8K resolution and displayed at the IMAX standard of 24 frames per second (fps). 4K digital content was also shown at 120 fps to highlight the impact of high frame rate (HFR) content on the visual experience, which is possible on the Christie Mirage 304K projectors.

Featuring the highest-resolution and brightest digital fulldome system ever demonstrated, GSCA’s Digital Dome Day marked the return of the live planetarium experience to Toronto after a 20-year absence. The Science Center of Virginia’s Justin Bartel presented public lectures during the Canadian Thanksgiving holiday weekend.

GSCA is the leading global association for advancing the business of producing and presenting educational giant screen and immersive theater experiences.

IMERSA News

Speaking of content production and cool new fulldome projection systems and standards, planning is underway for the 2017 IMERSA Summit, to be held in Denver February 22-26, 2017. On the table for discussion via various panels and speakers are topics of interest to the fulldome community, including further conversations about maintaining science accuracy in a production and the relationship between full-dome content and VR, as both mediums continue to grow and mature.

The Summit will once again feature selected fulldome presentations, plus keynote speakers, demonstrations, and much more. Bookmark IMERSA.org and keep checking for details and updated information about the Summit.
This September, I had an entire school visit the planetarium over the course of three days. The school normally sends its summer school students to the planetarium for a visit and this has created a strong tradition that is evident in the questions that get asked by the fifth graders during their visit. Many of the students were asking upper level thinking questions that may have been percolating in their minds since their last trip to the planetarium.

However, shifting from their normal 150 students during the summer to the full 400 students did have to change a little bit of the logistics. The order of attendance of the groups was set by the school to minimize the number of buses needed to transport the students. The topics were specifically chosen so that they would add on to or expand topics covered during the summer and not overlap.

Within our state education standards we are limited in some of the topics, so I am able to make a couple of exceptions, such as covering moon phases in fifth grade instead of sixth, by modifying the vocabulary used.

The “Size of Objects” lab

One of the lessons that I felt was very successful was the lab connected with the first grade’s Size of Objects in Space presentation. The weather was nice outside, so I set up a series of interactive stations that the students could go through. I had prepped the teachers with note cards with common questions the students may have at each station so they could be a part of the activity.

Many of the stations’ materials fit into a grocery bag that was brightly colored and easy to see on the field. Station 1: A bag containing a standard hardball and basketball. The basketball represented the Earth and the baseball was the moon. The card at that station: predict what it would be like if the moon was the size of a golf ball. There are two ways that the students could interpret this station. Most made statements like “it would be harder to have eclipses” and “the tides wouldn’t be as strong.” Another question to them: “what other object could be used to show the size of the Earth if the moon was sized after a golf ball.”

Station 2: A bag with another hardball and basketball situated on the basketball court. I marked the center of the court with an E for Earth and an M for the moon 8.5 meters away. Two people from each group grabbed the “Earth” and “moon” and stood on the letters. The rest of the group held hands to make a spiral from the Earth to the moon. The card in the bag reminded the students that it would take a lot of fuel to travel in a straight line from the Earth to the moon so spiraling out would be better.

This station was a refresh on the Station 1, but the focus was to demonstrate to the students that the moon was far away and it is small object. Normally the kids were able to spiral out and just touch fingertips to get to the moon. A teacher’s first instinct would be use yarn or string to have the kids make the path to the moon, but they would get fixated on using the string to make a straight line. It is easier to have them make a spiral using their bodies.

Station 3: This bag has a basketball with a 3-mm bead taped to the equator. The basketball now represents the sun and the bead is the Earth. (I learned the hard way not to glue the bead to the ball as there is always at least one kid who will want to dribble the ball. I found that a couple of layers of tape worked very well to secure the bead to the equator seam.)

The note card in this bag asked if they agree that most of the mass of the solar system is within the sun.

Station 4: Using the soccer field as a giant ruler, I placed traffic cones on the field to represent the planets, using a scale of 2m:1AU with one of the goal lines as the sun. The note card for station asked, “Predict how big the planets would be in this model: are they going to larger or smaller than a golf ball.” I labeled my traffic cones with dry erase markers with the name of the planet on the side and the scale distance on the base so that it would easy to set up quickly.

Station 5: Was one of the most abstract and while the students liked it, I feel that I want to do a bit more modification to make it a better activity. It was to help the students visualize the layers within the Earth.

I used the tent anchor and string technique to mark out arcs on the sidewalk. The first chalk mark was at a radius of 127 cm for the inner core. The outer core arc was at 354 cm, and the mantle was at 642 cm. The asthenosphere was at 662 cm and the lithosphere was marked at 672 cm from the tent anchor.

The chalk labels for the layers within the planet were quickly scuffed away, so the question on the note card asking for the name of the thickest and thinnest layers was difficult after the second or third rotation.

The other thing the students had trouble grasping was that it is a cross section of the planet. I was only able to get half of circle on the sidewalk so for the students it was not as concrete as I would have liked. I had several students ask if it was parts of a crater and the teachers had to repeatedly state this was the inside of the Earth. I think if I do this again, I would find an area to put down a full circle for each layer and then use tape for the labels, like I did with the M and E from Station 2.

Station 6: How to use eclipse glasses and a Sunspotter telescope. At this station I wanted to give the kids a little experience with eclipse glasses before the total solar eclipse next August. I know that I will see many of the students during the summer school shows, but I want to give everyone a little bit of the experience. I decided to include the Sunspotter because I wanted to show the students a second safe way to observe the sun and check if we could see any sunspots.

The groups of 40 were broken into smaller teams of 6-7 students with (Continues on page 74)
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LIP Service

LIPS 2016 wrap up

The sixth Live Interactive Planetarium Symposium has come and gone, and once again it went by all too quickly. I want to thank our hosts, Spitz, Inc. for all of their efforts, especially their hospitality and attention to detail. We all felt welcome, the food was fantastic, and we even had a tour of the facility (the dome building section in particular is amazing!). They ran airport shuttles between their headquarters and Philadelphia International Airport, which definitely facilitated travel. We really appreciated everything Spitz did.

I reviewed the philosophy behind LIPS in my June, 2016 column. You can see that issue or the LIPS website (LIPSymposium.org) if you’re curious about why LIPS is structured the way it is.

In this column, I would like to take the opportunity to share some of the highlights and happenings of LIPS 2016.

We once again had about 40 attendees this year, with a nice mix of veterans and new faces. Sessions covered a wide variety of topics, such as hosting successful star parties; activities for the August, 2017 solar eclipse; hands-on physics demonstrations; using Broadway tunes in programs; poetry under the dome; and more. All sessions were held in a dome—we even had lunch in a dome.

One of my favorite activities was the surprise visit from Galileo Galilei on the first evening. I had heard many good things about Mike Francis’s program “The Starry Messenger,” but this was my first experience with it. Galileo was informative, sassy, and funny; the time went by far too quickly. Bravissimo, Signore Francis!

Mike Francis also led us through some improv exercises the first morning of LIPS. This was a nice way to get to know each other early on in a fun and relaxed setting, and the exercises were designed to assist with rolling with the punches—a critical tool for any presenter of live, interactive lessons.

Another highlight for me was the eclipse shadow demonstrator from John Erickson of the Lawrence Hall of Science at the University of California Berkeley. Who knew that four tennis balls, a light bulb, and a colander could be so much fun?! This session sparked ideas for use in our Pacific Planetarium’s exhibit hall.

I personally have only presented interactive lessons in small domes, the largest being the 8.2-m Willard Smith Planetarium at Pacific Science Center, with concentric bench seating for 40 people. As such, I found Kerri Kiker’s (The Cradle of Aviation in Garden City, New York) session on hands on activities in a large dome particularly thought-provoking and inspiring.

I have had people comment to me that interaction only really works in small domes. I’ve never believed that, but I had no personal experience to back up my belief. Kerri demonstrated several activities they use successfully with audiences in their 24-m dome with 300 seats. I hope to try it out myself at some point.

What did others have to say? Here are some survey comments from LIPS 2016 attendees about what they considered to be the most beneficial sessions:

Survey comments tell the tale
- “Life in the Biodome” inspired me to promote our planetarium as a teaching space for non-astronomical topics.
- “NASA’s Museum Alliance and You” helped clarify the goals of the Museum Alliance (See more about the Museum Alliance on page 48) and what JPL can do for us.
- [Mapping the] constellations, poetry, star party, eclipse activities. My favorite was probably the poetry.
- Galileo was an incredible theatrical experience.
- Mike Francis as Galileo was inspiring, at first I had to look around to see if it was really Mike, then at some point I forgot that it wasn’t Galileo!
- Sessions that taught me things—especially [Dave] Bradstreet.
- Hard to pick, I found something beneficial in just about all of them!
- All vendor workshops were helpful in updating a person like me who has been out of the loop for a while about current planetarium technology.

As noted in my June, 2016 column, sponsors play a very different role at LIPS. There is no exhibit hall and only one level of sponsorship. Sponsorship fees are set very low ($350 to $500 over the years), making LIPS affordable for just about any company.

(Continues on page 74)
An endangered reef
a lunar riddle,
two fish on a mission!
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Having just returned from the 2016 GLPA conference in Flint, Michigan, I reflect on the great set of educational offerings there: in paper and posters, but also as the GLIPSA workshop, coordinated by Karrie Berglund.

As at IPS 2016 in Warsaw, planetarium educators shared many creative and useful ideas that can help improve each person’s local curriculum. Whenever possible, do attend conferences and seek out the offerings that relate to your own circumstances.

Following the meeting of the IPS Education Committee at IPS 2016, where we brainstormed project ideas for IPS, I inquired (via e-mail) which projects were of greatest interest and who could step forward to help. There is much support for increasing planetarium education information on the IPS website.

This project, however, probably will need to wait until the IPS Vision 2020 resolves what overall changes are going to be made in our website. Currently Alan Gould, a member of the Education Committee, and Planetarian Editor Sharon Shanks have done a lot to help website communication, and I know they will continue to do this.

Related to the topic of greater IPS website communication is a project goal of publishing some excellent planetarium lessons translated into different languages. We must identify website procedures and determine one or two best lessons to start this project. We will be constrained on the number of languages we publish for a lesson by the number of people who volunteer who have different language translation ability. If you are willing to translate a lesson into a particular language from English, would you please contact me at jeanneebishop@wowway.com.

Many who attended the summer meeting and others who are members of the Education Committee voice interest in educational research in the planetarium that will either or both 1) improve planetarium practices and 2) justify planetarium practices. Research expert and Education Committee member Shannon Schmoll thinks that a single project with research done at many planetariums worldwide would have problems, so that local individually-conducted projects are best. The Education Committee can and should take a position of offering ideas for local research and then helping to publicize results.

Some extrapolations should be possible, but since there are so many differences among local situations, extrapolation should be done with caution. At IPS 2016 Shannon, Julia Plummer, Chrysta Grant, and Ka Chun Yu gave an excellent workshop demonstrating how questions and topics important at the local level can be identified. Their previous Planetarian article, “Conducting Educational Research in the Planetarium,” will continue to serve as an excellent reference. (ips-planetarium.site-ym.com/?page=ConductingResearch)

Beginning with our spring column and in each succeeding Planetarian issue, we will present one or two ideas for educational research that you might initiate at your own planetarium.

Finally, Education Committee members are excited about continuing our video lesson project, led by Oded Kindermann. Please see the details of our video project now on the IPS website. (ips-planetarium.site-ym.com/?page=EdCommVideo)

Astronomy education in Czech Republic

I am delighted that Education Committee member Tomáš Gráf has completed his study of astronomy education in the Czech Republic, which follows on page 68. This seems an appropriate time to share his information, after the International Fulldome Festival in Brno, Czech Republic, during the week before IPS 2016.

Tomáš reached out to planetariums, mostly planetarium-observatory institutions in both the Czech republic and Slovakia, to learn what they are doing and how they interpret educational and popularization roles. I find it interesting that sometimes a term “tuition” (which in most English-speaking countries means the funds charged by a school for its student program) is used in these countries to denote formal education. Trying to communicate the usual meaning, I have changed “tuition” to “formal education” in the discussions by Czech Republic and Slovakia planetarians.

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IQ 4K gives you ultra-high definition imagery and superior brightness. Why settle for more expensive displays that don’t offer the education features of SciDome?
Formal and informal astronomy education in the Czech Republic and Slovakia

Tomáš Gráf
Institute of Physics, Faculty of Philosophy and Science
Silesian University in Opava
Czech Republic
tomas.graf@fpf.slu.cz

Pre-university Level
In the Czech Republic, at the pre-university level, astronomy is not taught as a separate school subject. The elementary and high school education content is declared in a so-called General Education Program (GEP), which can be expanded by individual schools.

The minimum level of knowledge is given by the GEP, but the actual content, including astronomy material, differs from school to school. The number of lessons dedicated to astronomy in subjects such as physics and geography differs at each school due to their curriculum choices and interest and knowledge of individual teachers.

In elementary schools, astronomy is included in subjects of geography, physics, and chemistry.

In high schools, the amount and type of astronomy depends a lot on the type and focus of the particular school. Some schools do not provide courses in mathematics, physics, or chemistry.

Universities
At Charles University in Prague it is possible to study astronomy up to the Ph.D. degree. Details and opinions at Czech Republic and Slovakia planetariums and observatories. For the growing number of planetarium shows, there is concern about how to classify a particular planetarium program. Should a particular program be considered a form of teaching and educational or should it be only a form of “popularization?” The terms popularization and education and popularization show are interpreted in specific ways by the staff at each planetarium. The following are descriptions of activities and interpretations of the education/popularization dichotomy from staff at Czech and Slovakia Planetariums and Observatories, which I solicited in a written survey.

Planetarium Teplice—Petr Dusek

The boundary between an educational show and a popularization show is often very narrow and I would say sometimes indefinite. Children need things to be explained in a popular form.

Observatory and Planetarium in Hradec Králové—Jan Vesely
Our shows for schools are educational and based on the GEP of the Czech Ministry of Education, in the category of “Youth and Sports.” We have 13 shows for elementary and high schools. We offer a children’s astronomy club, an astronomy course with focus on contact with the sky at night. A popularization show should explain some particular topic to the general public in a popular manner. That means that it should use comparisons and parables rather than sober facts. The boundary between an educational show and a popularization show is often very narrow and I would say sometimes indefinite. Children need things to be explained in a popular form.

Techmania Pilsen—Tomáš Meiser, head of the Planetarium Department
If we talk about purely educational activities, which I consider to be seminars for teachers, astronomical courses, or supervision of talented students, then we do not provide any of these.

Planetary education

Planetarium Teplice—Petr Dusek

Bromo Observatory and Planetarium, Planetarium Ostrava, Observatory and Planetarium in Hradec Králové, Planetarium Teplice, Planetarium Most, Planetarium Cheb, Observatory and Planetarium České Budějovice, Interactive Science Museum “Pavol z poznání” (Fort of Knowledge) Olomouc, Science Centre IQ Landia Liberec, and Techmania Pilsen.

Regional, municipal, and private observatories also exist in the Czech Republic, and they are operated by professors or amateur astronomers. These observatories are supported by the Czech Astronomical Society, which next year celebrates its 100th anniversary. Approximately 600 professional and amateur astronomers are members of this organization (See astro.cz).

Education and Popularization
Details and opinions at Czech Republic and Slovakia planetariums and observatories.

For the growing number of planetarium shows, there is concern about how to classify a particular planetarium program. Should a particular program be considered a form of teaching and educational or should it be only a form of “popularization?” The terms popularization and education and popularization show are interpreted in specific ways by the staff at each planetarium. The following are descriptions of activities and interpretations of the education/popularization dichotomy from staff at Czech and Slovakia Planetariums and Observatories, which I solicited in a written survey.

Planetarium Teplice—Petr Dusek

If a show is related to the curriculum and extends it, then it is educational. As for the kindergarten, it usually represents the first children attending primary schools, and an astronomy course intended for teachers of primary school.

Visitors to our facility sometimes do not distinguish between the informal and formal activities. I perceive education as a voluntary activity, motivated primarily by a person’s interest. Therefore, people can educate themselves on their own. Popularization is informal education. On the other hand, formal education is a process that usually takes place in schools. People do not always participate

(Continues on page 70)
“Like sitting inside a giant eggshell”
Dr. Jeffrey Kirsch - Reuben H. Fleet Science Center

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(Education, continued from page 68) voluntarily in formal education.

Our public planetarium and observatory programs primarily are perceived as popularization or informal education. Since many view us as mainly as a scientific institution, our activities for the public are seen as popularization of our scientific work.

Elementary and High School Groups: My experience has shown that about three-fourths of teachers bring their students to the planetarium and observatory to integrate it with their teaching goals. A small number of these teachers even require their students to complete worksheets. These teachers choose the topic of a planetarium show so that it relates to classroom work. Our show offerings follow the GEP of the Ministry of Education’s Youth and Sports. In letters to schools, we note the relationship of our shows to the GEP.

The other one-fourth of attending teachers do not appear to care very much about planetarium show content. They are happy with any topic, especially if children enjoy it. The children always seem to view the visits to the planetarium and observatory as entertainment. Although I view our activities as formal, I believe there is a very narrow boundary between this and popularization.

Classes from universities, including teacher training: Everyone (students, instructors, myself) seem to consider programs for groups from universities as education, perhaps formal as well as informal, since attendance is obligatory and the students receive credit.

Observatory and Planetarium Prague—Jakub Rozehnal, Head of the Observatory

Our facility currently offers two regular astronomy courses and one ongoing astronomy course for employees and colleges.

Our astronomy club (called our “Academy of Space Travelers”) is intended for students ages 12-15. The club involves a series of lessons based on a former two-year course organized in the 1980’s at the Observatory and Planetarium. At the beginning of each year, students are selected, and they attend lessons with older colleagues.

The lessons seem to be useful to the older students, even though they are repeating them. The repeated lesson format involves the older students teaching the younger ones. There is a 90 minute weekly lesson, and a total of 30 weekly lessons from October-June.

Students in the Club take trips to the Astronomical Institute of the Czech Academy of Sciences in Ondrejov and other planetariums and observatories. For all who attend regularly, we organize a week-long summer astronomy camp at Observatory Rokycany, which we call “Holidays Under the Stars.”

Since our last academic year, 2015-2016, we also offer two more student club opportunities. For children in grades 1 and 2, we present a 90 minute lesson every two weeks. We alternate astronomy and other science topics, providing children with basics useful in later years.

For children in grades 3-5, we offer a lesson format similar to that of the astronomy club for older students. But a main difference is and clubs, knowledge is tested.

I am personally involved in both. I present lectures during all of the first year and about one-quarter of the second year in the two-year course. I examine the theory part of final exams. I am aware of the difference in presenting for a class/club and the public. For the public, I present with the goal that people want to come again. For the public I try to simplify things and make them illustrative. In the astronomy courses, my total goal is student education. This means that some students quit. Usually half of the original number of students attend the second year of the course. Acceptance for the second year is not conditional on passing the final exam for the first year.

Observatory and Planetarium Brno—Pavel Gabzdyl, Deputy Director

Our school planetarium shows have a different structure than our shows for the public. Topics for school shows are selected to match material they wish to cover. We count the number of requests we get for a topic as feedback (for example, the solar system is very popular), and plan our offerings accordingly.

The school shows contain live parts and quizzes, which help children to remember material and test their learning. We make worksheets available for most of our planetarium shows, but they are for use by the students when they return to their schools.

We do not use a special classification of the shows we have for the public. We would like to have a different type of show for schools than for the public. However, the separation is financially more demanding for us.

Slovakia, Observatory and Planetarium Žiar nad Hranom—Tomas Dobrovodsky, Head of the Department

Our activities seem to be on the boundary of education and popularization. However, we try to offer programs and activities that specifically educational.

Most of our visitors are students from schools. Their visits constitute a part of their curriculum planetarium show visualization

(Continues on page 72)
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and information, including the current night sky and interactive discussion connected to models of the solar system are an integral part of their expected astronomy concept learning.

Other regular educational activities are:

- Preparation of attendees of our astronomy courses for the competition, “What do you know about stars?” (includes sky orientation and astronomical coordinates);
- Regular summer training for participants of the International Astronomy Olympiad in the planetarium;
- For university courses, specific programs demonstrating sun paths for different seasons at different latitudes and motions of other sky objects.

Other irregular educational activities are:

- Course on planetary geography for university students;
- Seminars for teachers ad organizers of astronomy courses;
- Special demands of visitors to our planetarium.

Observatory and Planetarium Hurbano—Marian Vidovenec, Director

Popularization in the planetarium is an activity that does not have to be solely about astronomy. In our situation, the purpose of popularization is to attract people to the planetarium. Popularization can be a planetarium concert, planetarium musical theater, reading of literature, or question-and-answer sessions. In these situations, astronomy topics can be presented as complementary features. This popularization is a method of attracting new planetarium visitors.

Another level of popularization is in our everyday work, as we present explanations for lay people, who are interested in astronomy. This is where the boundary between popularization and education lies.

My idea is that formal education is a purely school activity or one which we can provide within a course. In either case formal education has a given curriculum which has specific expectations of student learning.

One of our educational offerings is a post-high-school astronomy study. Intended for working people, it is designated as a two-year high school program. At the end of the two years, there is an exam, which forms the specialized part of the “maturita,” the school-leaving exam.

Other educational activities are internships for university students and organization of special lectures for physics and geography students. We have a contract with the university in Nitra to organize an astronomy lecture series for physicists. Some of these lectures take place in our planetarium and our observatory.

One could also classify our astronomy camps for students as an educational activity, particularly our “Meeting of Young Slovak Astronomers” for students older than 15. The level of the lectures and the practical activities in this camp is quite high. Our competition, “What do you know about stars,” in which can demonstrate their knowledge of astronomy, is another educational offering.

In our planetarium, we present mostly astronomy, and most of our visitors come with school groups. I consider this an educational activity, but I realize that is here where the question of a boundary between education and popularization arises.

I think this situation in planetariums is similar to that found currently in many countries, so it is a world-wide challenge for every planetarium to acknowledge the different functions of planetarium shows and pursue greater development of the planetarium’s strong educational potential.

Tomás Gráf

I define these categories of planetarium use:

- Astronomy popularization in the planetarium: Astronomy learning in which emphasis is placed on maximum experience and positive emotional response by the visitor.
- Astronomy education in the planetarium: Visitors are actively involved in the show and should receive some complementary materials, which allow them to revisit the topic/topics outside the planetarium.

Programs that take place in our lecture theater are purely educational, while the functions of planetarium shows are ambiguous.

Conclusions

Planetariums play a very important, positive role in the popularization of astronomy. Based on responses from my survey of Czech Republic and Slovakia planetariums and observatories, I conclude that staff at these institutions realize that there is a difference between education (general and formal) and popularization. Some planetariums categorize their shows according to recognition of criteria for education and popularization, and this is a positive measure. However, the realization of the difference is not always applied.

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I define these categories of planetarium use:

- Astronomy popularization in the planetarium: Astronomy learning in which emphasis is placed on maximum experience and positive emotional response by the visitor.
- Astronomy education in the planetarium: Visitors are actively involved in the show and should receive some complementary materials, which allow them to revisit the topic/topics outside the planetarium.
- Astronomy “tuition” (formal education) in the planetarium: There must be a feedback (testing of knowledge). It is not possible for the visitor (student) to take part in activities without mental effort.

Acknowledgements: The author is grateful to all who replied to the survey.

EDGE OF DARKNESS

Narrated by Hayley Atwell

Now Available
(LIP Service, continued from page 64)

Each sponsor at LIPS 2016 received 30 minutes of presentation time, and we were encouraged to use that time to teach the audience something, ideally by having a customer present. This sponsor role seems to work well for LIPS attendees, given comments on the survey:

- I hardly realized that they were sponsors, and not just another presentation.
- I thought the sponsor role was great, and 30 minutes was a good length.
- I was so impressed with the way sponsors were represented that I discussed this as a possible recommendation for my regional (called a board member to discuss).
- I really like that the sponsors are part of the sessions—they have an important perspective in terms of their products, but they also offer a fresh view at times.

Many thanks for their full participation.

We had six sponsors at LIPS 2016. In alphabetical order, these were Audio Visual Imagining, Digitalis, e-Planetarium, Evans and Sutherland, Seiler Instruments/Zeiss, and Spitz, Inc.

Thank you again to all of the sponsors for your participation in LIPS and support of live programs.

We also collected general comments on the LIPS 2016 survey. Here are some of those:

- Fantastic meeting. We should all refer to LIPS as a master class for planetarians.
- Glad to see so many new attendees, while maintaining a good overall size for the meeting.
- I never felt any session dragged, in fact they all seemed to fly by, so time was good.
- The presentation time is what I dream regional conferences will duplicate. Nothing felt rushed, there was time to participate and assimilate the ideas being presented!

(One Dome, continued from page 53)

like the Christmas star or constellations for the given season. The third has the new show that might go for three or four months at a time and then change.

I have noted that a number of visitors have come back and brought others. They, in turn, have returned and brought more. While many have not returned, there is almost a steady state continuing flow of new faces introduced to the star barn by those who have come before. So, basically, I have stopped worrying about how to draw people in. While it might not seem like much, my attendance has just passed 1,000 people, surprising considering my little planetarium is hidden away in a residential neighborhood and my only advertising is by word of mouth.

One page of the LIPS website is dedicated to documents, links, and more, from previous symposia. If you’d like to get some ideas for live programs or see what you’ve missed, that URL is IPSymposium.org/LIPS/node/48.

You’ll find information there on how to build John Erickson’s eclipse shadow demonstrator and Dave Bradstreet’s fabric gravity well, links to Great American Eclipse information, and more.

As the only person who has attended every one of the six LIPS to date (unfortunately Keith Davis and Mark Webb both had to miss this year), it has been interesting and rewarding to watch LIPS evolve. The basic structure and participatory, inclusive nature of LIPS has remained the same, but the presentations have become notably stronger over time. I don’t mean to say that the presentations at the early LIPS were bad—they certainly were not—but rather that as the level of interactivity has increased, there has been a subsequent increase in the quality and relevance of the offerings.

This evolution has made a strong professional development opportunity that started out strong even richer. It has been exciting to see LIPS grow and flourish over the years; it has exceeded all of my expectations. As always hoped, LIPS has created a strong community of like-minded, supportive professionals who are incredibly generous with their time and feedback. I look forward to the increased involvement of IPS’s Presenting Live Under the Dome Committee and helping to spread the LIPS culture even farther afield.

Plans for LIPS 2017 are underway

Finally, some information for the future: Plans for LIPS 2017 are coming together nicely. The dates are July 18-21. Our host will be Ball State University in Muncie, Indiana, which did a fantastic job hosting the 2014 Great Lakes Planetarium Association conference. There will be three days of regular LIPS-style programming from July 18-20, followed by a day dedicated to teaching astronomy 101 on July 21.

The astronomy 101 day will be organized and led by Tim and Stephanie Slater of CAPER fame (Center for Astronomy and Physics Education Research, www.caperteam.com). I am already excited for LIPS 2017—it’s going to be an absolute blast.

If you’d like to join the LIPS community, there are two easy options: the LIPS Google Group and a LIPS Facebook page. I can invite people to join either or both of these. Just send me a request at karrie@DigitalisEducation.com.

And, as always, please send comments or questions to me at the same address: karrie@DigitalisEducation.com.

(Data to Dome, continued from page 58)

were able to stream the Nergis Mavalvala lecture at the highest resolution currently available through YouTube, 1440p (2560x1440). Once 4K streaming is enabled we will be able to stream the equivalent of a 2K planetarium show.

Towards true VR simulcasts

The terms “virtual reality” is horribly abused, something that I have been guilty of in most of this article. A true VR experience should involve a fully immersive stereoscopic display system as well as user tracking so that that space can be explored. Ideally other senses are involved as well, for example spacial audio and haptic feedback interfaces. Our initial attempts described above are simply streaming 360 degree video. The user has the ability to look around, but is not able move about that space. Progress towards true VR simulcasting will occur in phases:

Phase 0 is the simulcast of 360 degree video accompanying a live planetarium presentation. It was achieved October 28 2016 with the Kavli Fulldome lecture.

Phase 1 will be the simulcast of stereoscopic 360 degree video accompanying a live planetarium presentation. Further development is necessary, but this is entirely possible with today’s technology and I expect that it will be achieved within the next year.

Phase 2, true VRcasting, will require more work. In this case a solution closer to domecasting makes more sense. VRcast participants could run a version of the planetarium software on their VR device and receive the configuration information from the domecast.

(Classdome, continued from page 62)

them rotating every 5 minutes. This gave the students a chance to burn off some excess energy before getting them to the buses. The teachers liked this activity set because it gave the students some hands-on time with the topics we covered in the planetarium and covered a little bit of eclipse preparation.

Not every grade level presentation had labs to go with it, but they all had the eclipse preparation. I mixed it up, including journaling activities, guided math problems, and art projects. These diverse topics for activities were driven by analyzing data from the exit surveys from last summer’s groups. The teachers wanted to involve more people on the staff with the astronomy unit and bridge science into other curriculums.

This is a little preview of what is to come during the next from the Classdome; in the spring will be some strategies and suggestions for making surveys for some of your groups. ☆
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Audio Immersion Systems: Concepts, Challenges, and Solutions

By the IPS Immersive Audio Committee

In an age of media saturation, the strength of the planetarium is its immersive realism and sense of wonder. An immersive audio system should support this mission in every way. To aid in the decision-making process about potential audio systems, here are what some of the foremost companies working in immersive planetarium audio are thinking about, and how their work can support the planetarium’s vision.

Audio immersion is a crucial component in planetarium design, but installing a new system can be complex, and not all the important considerations may be immediately apparent. While budget and installation logistics are necessarily foremost concerns, there are other important factors to consider as well. Ease of workflow, the possibility for content migration between systems, the ability to integrate with live instruments or performances, and aesthetic compatibility between the audio system and the space itself can all be part of the initial planning process.

An effective planetarium experience lets the audience travel to the outermost reaches of our knowledge and ambition, as well as the depths of space, and audio is uniquely equipped to support this sense of discovery. As the non-visual sense, hearing plays a role more subconscious than that of sight.

Sound: a subconscious cue

Just as movie scores become subconscious cues to an audience about emotional content, your immersive soundscape can be a subconscious cue to your audience that they have truly traveled to a new place, emotionally and intellectually.

But first there are the technical challenges. Dan Neafus of Gates Planetarium and IMERSA says of the trials endemic to his institutions’ relationship to sound: “The important first step is to set guidelines for 5.1 and 7.1 sound: speaker placement, room acoustics, sound levels, measurement methods. This is much like the important first steps of IMAX. Producers of content need predictable delivery. Recognizing these issues for decades, IMERSA and IPS will be developing and publishing guidelines.”

Immersive audio professionals in the field have been thinking about these issues for decades. Jeff Bowen of Bowen Technovation, which has installed systems in over 300 domed theater worldwide, posits a given: “Every site has different architecture, objectives, mission statement, acoustic treatments, dome material, dome tilt, seating arrangement, etc. There are no “cookie cutter” designs that fit all…” He adds: “All our systems use high-powered DSP solutions that enable the audio from very device to be usable at the same time. Not all systems do this.”

A setup independent of speaker position

René Rodigast of the German company Fraunhofer notes, “Our setup is relatively independent of speaker position. We have typical recommendations for setups depending on projects. Our hardware is typically Linux realtime rendering on PC or as “Atmosphere” together with QSC Q-Sys. The interface Madi and Dante, Tracking, OSC, MIDI and more. Integration with projection is over timecode and OCS. And our content format is multichannel wav + LTC timecode track + spatial sound metadata file, or all in spatial file format, container free and scalable.”

Charlie Morrow of MorrowSound adds: “Our objective is to create a powerful and unique sound experience for the visitors and creative team. Using MorrowSound’s patented immersive sound processes, the sound can be controlled to be fluid or static; to jump over visitors or to pass around them; to assemble and disassemble. MorrowSound places speakers in the dome overhead and around the floor-level areas to create a fully immersive and layered soundscape with a minimum number of speakers, such as the 8.3 system in Wolfsburg. The MorrowSound system is also integrated with the projection system and can use third-party sound processors. It expands stereo and surround to full immersive.”

Pierre Brand of Primetime studio in Hamburg writes, “As a user of Spatial Sound Wave I use a loudspeaker setup according to specifications of the Fraunhofer Institute mapped to my studio.

“I am using a PC, Linux. My DAW is ProTools on a Mac, and the data connection to the PC is realized via MADI. The DA conversion is done with a d.o.tec Interface.”

Brand added a MorrowSound cube and piloted the new MorrowSound AAX plugins. He then mapped a production which was also mixed in Spatial Sound Wave to MorrowSound, commenting that “Mixing was fine and surprisingly effortless.”

Iosono has recently joined the Barco family. The “CORE processor delivers immersive high quality audio based on ISONO’s world-known wave field synthesis technology (WFS). With ISONO CORE, sounds can be moved within a defined space with unparalleled precision, resulting in a crystal-clear perception of sounds emanated from the walls of the auditorium.” The system is even able to eliminate the “sweet spot” (often referred to as a very specific position in a room with best listening results).

Dolby Atmos technology allows up to 128 audio tracks plus associated spatial audio description metadata (most notably, location or pan automation data) to be distributed to theaters for optimal, dynamic rendering to loudspeakers based on the theater capabilities. Each audio track can be assigned to an audio channel, the traditional format for distribution, or to an audio “object.”

With so many approaches and considerations, it pays to gather as much information as possible when deciding on an immersive audio system. For more in-depth discussion of these issues, the immersive audio committee of IPS will be presenting workshops at IMERSA and IPS conferences and events.
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Dear fellow planterians

As a planetarian, your closest colleague might physically be far away, but our community offers many ways of interacting with others around the world through small and large conferences, seminars, forums, exchange programs, etc. In this edition you can read about some fine examples of this and many other activities currently taking place.

For this section I’m indebted to contributions from Vadim Belov, Alex Delivorias, Loris Ramponi, Milene Wendling, Björn Voss, Anna Arnadottir, Mark Watson, Bart Benjamin, Sarah Twidal, Beau Hartweg, John Hare, and Ignacio C. Pinal.

Let’s start this tour around the globe in Russia.

Russian Planetarium Association

Moscow. President V. Putin appointed on 19 August Olga Vasilieva as new Minister of Education and Science. This is regarded extremely important, since the public rated the work of two former ministers very negatively. One of the first initiatives of the new minister was to return astronomy to a number of mandatory school subjects! Perhaps she will find the money for the Novosibirsk project referred to in Planetarian earlier? (See Vol. 45, No. 1, March 2016, the Children’s Park of Science and Technology.)

Nizhny Novgorod. The festival of sciences, arts, and technologies (FeNIS) has become an annual event. It was held this year for the 8th time in the last week of September on various bases of the city: universities, research institutes, libraries, museums, etc. The planetarium became one of the venues.

Topics included: life of the solar system, threats from space, galactic studies, riddles of modern cosmology, probable and improbable phenomena in the universe, the background radiation, a scientific method in cosmology for beginners, and other lessons with scientists. Up to 600 people attended these lectures by the leading scientists of the country over four days.

Novorossiysk. The conference of the RPA took place on 12-17 September on the occasion of the 55th anniversary of the Novorossiysk Planetarium. It began in city theatre with a performance devoted to Yuri Gagarin. Two guests of honor, chief designer V. Filin of the Rocket-Space Corporation Energiya (2007-13) and chief designer of the Soviet shuttle Buran and cosmonaut S. Treshchyov handed over a flag and a commemorative medal to the planetarium. A model of the spaceship Vostok has been installed in front of the planetarium in addition to a sculpture of Yuri Gagarin.

Guests from 18 cities of Russia, Belarus, and Kazakhstan could tell about their works, discuss problems, and share experience and plans during the conference. They listened to talks by O. Ugolnikov, staff member of the Institute of Space Exploration of RAS, titled “The upper atmosphere-a meeting of Earth and space” and “The All-Russian Olympic games of school students in astronomy;” by the chief executive of the Fulldome Film Society, Yaroslav Gubchenko, titled “About new decisions for digital planetaria;” by the director of Svensons Art Media, A. Lobanov, on “Import substitution whether it is urgent in planetariums” (in connection with sanctions); and by the chairman of the RPA board Z. Sitkova, with title “Planetarium–the launch pad into space.”
The participants visited the House of Aeronautics and Cosmonautics, the astronomical observatory in the All-Russian children’s center Orlenok in Tuapse close by, and the wine cellars of Abrau-Durso. Of course, the wine tasting left nobody untouched.

The conference coincided with the celebration of the anniversary of the liberation of Novorossiysk on 10-16 September, 1943 during WWII by a landing of the Black Sea fleet. Therefore, the day began on 16 September with a flower-laying by the Eternal Flame. The opening of the Black Sea regatta also took place at same time.

The planetarians had supper on the cruiser-museum Mikhail Kutuzov, walked on a motor boat on a bay, and some visited the big sailing vessels. In the evening, the performance And Tomorrow There Was a War... was shown in the theater.

Novosibirsk. The XI forum of SibAstro took place on 23-25 September. Twelve teams of school students from Moscow, a number from the Siberian cities of Russia, three from Kazakhstan, and experienced fans of astronomy took part in it. Astronomers from the main astrophysical observatory in the North Caucasus, and also the Kyrgyz astronaut Salizhan Sharipov from Star City, arrived for the first time to a forum.

Damien Beguet, director of planetarium from Saint-Étienne, France, was the main foreign guest. He showed the fulldome movie Polaris. The local authoritative lecturers were also present. The jam-packed conference room showed that major changes are necessary.

Both nights were clear and all participants of the forum admired much the scatterings of stars in powerful telescopes. It was the first time for many to observe them in devices of night vision. The rewarding of a medal of I. Yazev has become an important part of the forum. The medal is handed annually to a person who has made a big contribution to the promoting of astronomy. S. Yazev (grandson) handed the 8th award to the director of the Omsk planetarium V. Krupko, who has participated in all forums.

Pyatigorsk. The local planetarium had become a common place to dine during the difficult 1990s in Russia. A. Platonova, new owner of a small building with a spherical roof, decided that there were too many cafés in Pyatigorsk. She gradually purchased equipment and video programs and starting on 12 April, 2012 began again to talk about the planets and stars in Pyatigorsk. The pan-Russian conference Modern Stellar Astronomy was held in June in the Caucasian mountain observatory near Kislovodsk and a group of scientists visited with interest in the revived planetarium.

European/Mediterranean Planetarium Association

Croatia. In the first week of October, the Rijeka Astronomical Centre in Croatia celebrated the 2016 World Space Week. This year's main theme was Remote Sensing-Enabling Our Future and the Rijeka Astronomical Centre prepared for the occasion the planetarium show Earth-Jewel of the Universe. The show highlighted the purpose and importance of space exploration in general, but also focused on the exploration of our own planet from space.

During the same week, centre also celebrated the Children Week with live shows especially designed for the younger audiences. Throughout October, there was another live show on the night sky visible from Rijeka on this time of the year with a presentation of the autumnal constellations. Finally, at the time of writing, the Rijeka Astronomical Centre was scheduled to premiere the ESO planetarium show From Earth to the Universe in November.

Greece. Further south, on the occasion of the autumnal equinox, the Eugenides Planetarium in Athens invited Lars Lindberg Christensen, head of Education and Public Outreach at the European Southern Observatory, for a public lecture on the discovery of a planet orbiting Proxima Centauri, the potentially habitable exoplanet closest to Earth. The event, which took place on Monday 19 September, attracted large crowds and was complemented by three free-of-charge screenings of Life in the Universe, a show produced by the Eugenides Planetarium that focuses on the fascinating possibility of life beyond Earth and the search for exoplanets.

Also, on Monday 17 October, the Eugenides Foundation premiered its latest digital show titled Space Storms and the Polar Aurora. The show focuses on some of the most impressive and violent weather
phomena in the solar system, on solar activity, on the threat to our telecommunication satellites and power grids posed by solar storms, and on how the solar wind and the solar explosions interact with Earth's magnetic field, creating the polar aura.

**Italian Association of Planetaria**

The science and history exhibition titled Janello Torriani, genio del Rinascimento is open at Cremona's Violino Museum. Torriani was an Italian inventor born in Cremona around the year 1500, but more known in Spain than Italy. He studied mathematics and celestial motions. The exhibition contains armillary spheres, celestial globes, astronomical clocks, and the reproduction of the water machine invented by Torriani.

Organized by the City of Cremona with the support of Fondazioni Arvedi and Fundación Juanelo Turriano in Madrid, Spain, the exhibition will be open to the public through 29 January, 2017.

It is time to prepare a video for the Planit Prize. This competition, devoted to a video production like a fulldome show, is open to everybody. All materials must be sent to premio@planetarium.it by 28 February, 2017. The first prize is 500€. Participants must be members of Planit, and the association is open to everyone from all countries.

It is also time to include in the 2017 calendar the following dates: 12 March, the International Day of Planetaria; 22-23 April, the XXXII National conference at Alto Adige Planetarium, Cornedo all'Isarco, Bozen; 20 May, “Let’s Meet on Jupiter,” PlanItalia Network managed by PlanIt, projections and observations in many cities devoted to the public of all ages.

The Voices From the Dome project, promoted by Serafino Zani Astronomical Observatory, is now on-line on the IPS website at ips-planetarium.it. Every planetarian can contribute to this copyright-free digital archive.

The audio files can be used in a live planetarium show in the dome or during a lesson with Italian students (or from other countries) who learn English. For example, the database contains some audio files devoted to the description of celestial phenomena visible in the southern hemisphere, like Aurora Australis seen from Tasmania, the Milky Way of the southern sky, and the midnight sun observed from Antarctica. The voices of Martin George and April Whitt involve the audience during the description of these amazing splendors of the sky.

Other colleagues, everywhere in the world, are invited to collaborate in the project. It is very easy to send new audio file about any subject useful under the starry sky of the planetarium. See the website for more information.

At the end of the school year, the Prince of Naples Boarding School in Assisi, which has been hosting the Week in Italy project since 2013, organized a new initiative titled Assisi Summer Science School for the best of Italian middle and secondary school students. The students who attend are chosen on their merits and have a particular passion for the experimental sciences, astronomy, biology, and earth science, and the history of these disciplines.

Two workshops on astronomy were assigned to the StarLight... a handy planetarium Association, one dealing with the day sky and one with the night sky. Both two-hour workshops were planned for a group of 15 participants, and consisted of an interactive theoretical part and another practical one.

During the second part each student made two paper models, the astrolabe for getting night-time bearings and the “merinto” for the evaluation of the sun’s path. This second paper model contains in itself four instruments: the Hipparcos circle, the Ptolemaic plinth, the sundial, and the sextant. The two workshops ended with the observation of the sun and the night sky.

**Association of French-Speaking Planetariums**

Ten years after a transition to all digital with the installation of fulldome video, the planetarium of the Cité des Sciences et de l’Industrie of Paris is upgrading its projection system. Under the 21.5-m dome, the new equipment of 10 Sony video-projectors and 20 PC imaging devices contracted by RSA Cosmos will allow for 8K projection. This technology, which is unprecedented in France, will be a response to the public’s requirement in matter of scientific popularization shows. The opening is planned for the middle of February.

During three days in October, users of small digital planetariums met in the planetarium of the University of Strasbourg. They were collaborating on fulldome shows and scripting with Stellarium 360.

On 11-13 November, planetariums and the APLF were present at the Rencontres du ciel et de l'espace in Paris to exchange with the public and astronomers on the dynamics of the network of French speaking planetariums.

Finally, a new website of APLF is set to arrive in December.

**Society of the German-Speaking Planetariums**

Berlin is home to two large planetariums, the former West Berlin Planetarium am Insulaner and the Zeiss Großplanetarium in former East Berlin. The latter was closed for refurbishment starting in mid-2015, and was reopened in August of this year. It now features a new Zeiss Universarium Mk IX star projector—the world’s first with LED light source—and a Zeiss Velvet fulldome projection system. The fulldome image is delivered by either a Zeiss Powerdome, or SCISS Uniview, or E&S Digistar 6 render cluster.

In addition to the projection systems, a new (Continues on page 82)
INCOMING!

Asteroids, Comets, and the Hard-Hitting Stories of Our Cosmic Origins

Narrated by George Takei

Explore the past, present, and future of our Solar System in a new planetarium show, now available for licensing.

For info on ordering the show, visit www.calacademy.org/licensing or contact your preferred fulldome film distributor.
dome was installed, along with new audio equipment, seating, and significant changes to the building itself.

The opening show, *Sterne über Berlin (Stars above Berlin)* was produced in-house and is focused on the important contributions to the history of astronomy and astrophysics that were made in Berlin.

**Nordic Planetarium Association**

Sweden. In order to bring science education to everyone, Vattenhallen Science Center in Lund has started an ambitious project. Every class of 14-year old students within about two hours driving radius is invited to spend half a day at the science center and at the planetarium. The project is being backed by a local bank, making the transportation and visit free of charge to the schools.

Two themes are offered for these visits: either robotics or life science. At the planetarium, these teens get to see a show that was specifically produced for the occasion, titled Cosmic Light. The planetarium at Vattenhallen produces 1 to 2 shows per year, but these are in Swedish and have so far not been distributed.

Denmark. In Jels, the Orion Planetarium is fighting for its existence (yes, it is the planetarium of your editor for this section). During the last year funding from the University of Aarhus has been decreased, and by the end of 2016 it is pulling out completely. For continued operation after 1 January, the planetarium is working against the clock to find new fundings, sponsorships, and donations.

**British Association of Planetaria**

On September 23-24, the British Association of Planetaria (BAP) held its annual conference, hosted by At-Bristol Science Centre, Bristol, England. The event marked the 38 year since BAP started as a group of enthusiastic planetarians meeting up to swap stories, information, and share best practices.

This conference was our largest yet, with over two-thirds of our membership in attendance and vendors from across the globe showing their latest products and services.

This year we were able to provide a bursary to Daniel Chu Owens from the Travelling Telescope team in Kenya. His attendance would otherwise have been impossible.

The conference had a packed schedule of members’ discussion sessions, including: cross curricular links between the planetarium and other topics, empowering your presenters and a guide to training staff, and best practices for special educational needs groups.

We were fortunate to have two speakers for this year: Alistair Glasse from Science & Technology Facilities Council, talking about the James Webb Space Telescope and the Mid-InfraRed Instrument, and Dr Kevin Fong from University College London Hospitals, talking about the medical impacts of living in space.

**Great Lakes Planetarium Association**

**Illinois.** To prepare the community for the 2017 total solar eclipse, the Elgin Planetarium handed out moon flashcards and notebooks to complement the fulldome program *The Moon*. The materials allow students to do science at home by carefully recording sky observations.

Chicago’s Adler Planetarium’s new production *Planet Nine* has presented stunning visualizations of astronomer Mike Brown’s search for new worlds in the outer solar system. This summer, Adler’s Space Experience Truck made appearances throughout Chicago, engaging the public with hands-on activities, science demos, and free astronaut ice cream.

The William M. Staerkel Planetarium at Parkland College in Champaign replaced its nearly 30-year-old seats with Irwin Seating’s planetarium chairs. Staerkel was proud to open Solar Superstorms this fall, with visualizations created by NCSA, to celebrate its 30th anniversary on the University of Illinois campus.

This summer, the Peoria Riverfront Museum featured an exhibition titled Be the Astronaut, prompting the planetarium to create a live show titled Living in Space, which showed the many aspects of the human presence in space. In September, retired astronaut Scott Altman from Pekin, Illinois spoke at the museum for two events. The highlight of the summer programming was a live call to the International Space Station as part of the ARISS program. Students in the Space to Ground club had a 10-minute Q&A session with astronaut Jeff Williams as he orbited over Italy. Over 350 people attended.

**Indiana.** Indiana has a Bicentennial Star: Sheat (Beta Pegasus). Indiana astro-educator Chuck Bueter was the driving force behind this designation.

This past summer, the Koch Immersive Theater in Evansville hosted another in its series of Moon Festivals, which are meant to raise awareness for the 50th anniversary of the moon landings in 2019. Master storyteller Susan Fowler was the headliner at this event.

(Continues on page 84)
SOLAR SUPERSTORMS
NARRATED BY BENEDICT CUMBERBATCH

Honorable Mention
Espinho, Portugal
Immersive Film Festival
2015

Best Movie Award
Brno, Czech Republic
IPS Fulldome Festival
2016

Honorable Mention
Jena, Germany
Jena Fulldome Festival
2016
The Edwin Clark Schouweiler Memorial Planetarium at the University of Saint Francis in Fort Wayne formally closed on 30 June, after nearly 45 years of operation. The planetarium staff ran several free shows in June for those who wanted one final “Schouweiler Experience.” Most of the equipment has been transferred to nearby planetariums.

Michigan. In September, the Vollbrecht Planetarium in Southfield began a fall series of eight 90-minute live lectures covering a wide array of astronomical subjects.

The Abrams Planetarium, Michigan State University, East Lansing, recently received a fresh coat of paint in its theater and lobby, along with handicap-accessible doors. It also received a grant from the Dart Foundation to install three touch screens in its lobby.

The Delta College Planetarium in Bay City premiered a new film called *Life Under the Arctic Sky*, which follows the peoples of northern Scandinavia as they follow the migration routes of caribou. It also includes striking footage of the northern lights.

The Longway Planetarium in Flint hosted the GLPA conference, created a Halloween show, and developed an interactive Jeopardy game using Xbox controllers for buzzers.

The Besser Museum Planetarium in Alpena will soon become a proud venue for digital programming, Spitz, which installed their A3P 50 years ago, has been chosen to install the new digital equipment.

In July, the new biological science building, in which the University of Michigan’s Museum of Natural History will be housed, was “topped off.” The building was closed during this fall.

In April, the Roger B. Chaffee Planetarium in Grand Rapids debuted a live astronomy update show, *Breaking News from Outer Space*, which changes monthly with the most recent news in astronomy. This summer it hosted its first-ever Planetarium Masters summer camp, in which middle school-aged campers spent the week developing short astronomy programs using Digistar 5 effects.

The Kalamazoo Valley Museum presented *From Earth to the Universe*, a free show made available by the European Southern Observatory. Plans are underway to combine *From Earth to the Universe* with a live tour of the night sky.

Ohio. Jeanne Bishop of the Westlake Schools Planetarium gave a second summer of programs for Westlake’s summer school camp.

Jay Ryan of Cleveland continues work on *Generation Eclipse*, a free educational comic strip for helping Americans understand and prepare for the 2017 total solar eclipse. (See September 2016 *Planetarian*, page 42; AmericanEclipseUSA.com)

The Vandalia Planetarium at Smith Middle School opened its 46th year of continual operation this September with a show focused on constellations. Its October show was held on International Observe the Moon Night.

From the Bowling Green State University Planetarium, Dale Smith completed the encoding of 30 years of classic shows into the Spitz SciDome XD system; this labor-intensive work ensures that all prior programs will be available to visitors for years to come.

Wisconsin/Minnesota. The Bell Museum’s Minneapolis location will close on 31 December to prepare for its move to a brand new home on the St. Paul Campus of the University of Minnesota in 2018. In the meantime, they will continue to offer outreach experiences at community events.

The Gary E. Sampson Planetarium at Wauwatosa West High School received new carpeting and 60 new Irwin planetarium seats in late programs: *Nightmares in the Sky*, a show about the Greek monsters in the sky told from the point of view of the monsters, and *Northern Lights*. As part of the celebration of its 50th anniversary, the planetarium hosted a Rock ‘n Rockets event in November that combined stars with 1960s music.

Southwestern Association of Planetariums

For the first time in over three decades, the John Carl Pogue Planetarium, Grand Prairie, Texas is offering Planetarium Community Nights. The first four dates, with three presentations each night, were completely booked within three days after they were announced (the first program was filled within three minutes).

More programs are being added and the staff now plans to offer a Planetarium Community Night each month of the school year. Four of the programs will be offered in Spanish as well as English for the local Spanish-speaking community. The programs are free, but guests must register their visit, so there are not more attendees than seats. The staff is very excited about this change.

Starting as an idea between colleagues at the SEPA/WAC 2016 conference, the most recent Noble Planetarium (Fort Worth, Texas) intern, Beau Hartweg, looks towards adding new content to the educational programming that is currently being done. He is currently a graduate student at Texas Christian University, working towards a Ph.D. in Science Education.

He has been an avid planetarian for over four years now. Prior to entering the planetarium field, he was a high school science teacher for 5 years. His goal is to inspire people of all ages to “pursue lifelong learning in an ever-expanding universe of endless possibilities.” He has worked for Perot Museum of Nature and Science’s Portable Universe program since 2012, teaching the wonders of astronomy to students of all ages.

After attending many planetarium conferences and seeing the unique differences between the worlds of fixed and portable domes, (Continues on page 86)
NARRATED BY LIAM NEESON

Dynamic Earth
Exploring Earth’s Climate Engine

- Public Choice Award: Short Film - Oakville Transmedia Film Festival 2011
- Golden Star Award: South Korea Planetarium Fest 2012
- Award Winner: Malta International Ars Film Festival 2011
- Finalist: Science Media Awards 2012

Contact: Mike Bruno mbruno@spitzinc.com T: 610.459.5200

www.spitzinc.com/fulldome_shows

Spitz FullDome Show Distribution
Beau wanted to find a way to transition from the portable planetarium field into the fixed dome world. He has conducted planetarium research exploring factors that influence educator teaching methods, and he hopes to continue with planetarium research in the future.

His work at the Noble Planetarium is focused on four main areas: to learn how the fixed dome operates, both for school and public programs; to learn how to use planetarium software in developing shows; to design new and additional educational content; and to write and develop a fulldome program for the Noble Planetarium.

He is now just about halfway through his internship and has already worked to add content for one of the more popular school and public programs called *Our Amazing Solar System*. He is also working on the script for a fulldome program for the 2017 Solar Eclipse, and has in general helped with side projects to gain a fuller understanding for how the Noble, and planetariums like it, can operate on such a small full-time staff basis. Interns can be a blessing to domes like the Noble planetarium, and at Noble they believe they have been granted such a blessing.

Donna C. Pierce of the Highland Park Pierce Planetarium in Dallas, Texas was able to visit Natasa Stanic while in Belgrade on her Danube River Eastern Europe tour in July. The Zeiss model there is numbered in the 200's and is almost an antique, but still doing a good job. The planetarium is located at the Kalemegdan fortress and is open for grades K-12 with public shows on the week-end.

**Southeastern Planetarium Association**

The association is looking forward to the Pleiades conference, a coalition of all 7 US regions, hosted by the James S. McDonnell Planetarium at the St. Louis Science Center in St. Louis, Missouri. Conference dates are 10-15 October, 2017. Watch for specific conference information to be available before the end of 2016.

SEPA has reserved the entire accommodations facilities at Lake Barkley State Resort Park in western Kentucky for the total solar eclipse on 21 August, 2017. The accommodations are available to SEPA members who are paid thru December, 2017. It is expected that the resort will be completely sold out by sometime this winter.

The resort’s reservations desk maintains a list of current SEPA members so identify yourself as a SEPA member to qualify for the booking. See www.parks.ky.gov/parks/resortparks/lake-barkley for more information. You should act quickly if you want to take advantage of this tremendous opportunity.

The Pink Palace Planetarium and Museum in Memphis, Tennessee has been chosen for the 2018 SEPA conference. Dates are 5-9 June.

**Association of Mexican Planetariums**

The Quintana Roo Science and Technology Council recently gave out a publication titled *Quintana Roo Planetary Network* aiming at presenting to the Quintana Roo community the description and impact of the network. By analyzing the executive projects and the contribution of CEOs of the planetariums, the physical and human infrastructure, architectural society, and architectural and functional design, museology and the impact it has had on the society are described, particularly in the social appropriation of science, technology and innovation.

The Chetumal Planetarium Yook Ól Kaab, Planetarium Cancun Ka’YoK, Planetarium Cozumel Cha’Kan, and Planetarium Playa del Carmen Sayab, constitute the Quintana Roo Planetary Network. All of them have been covered briefly in the AMPAC column of International News in the former issues of the Planetarian. However, it is worth mentioning the exemplary and relevant science and technology diffusion projects achieved by the Quintana Roo State Science and Technology Council in collaboration with Mexico’s National Science and Technology Council for making possible the construction of four digital top-of-the-line planetariums during the last five years, a feat worthy to be followed by other states in México.

A statement by Thomas Kraupe, former IPS president, is recorded in the December 2015 *Planetarian* issue, when he participated in the II International Planetarium Festival in Cozumel, Quintana Roo. He encouraged us to take advantage of the “Dual Year 2016-2017 Mexico-Germany,” establishing a collaboration line between the Quintana Roo Planetary Network and Germany, and profiting from the system they have and offering the Mayan cultural richness and biodiversity to the world. For those interested in downloading a copy of the publication, it can be found at www.medaiire.com/download/72t8a8xwq0626q/FOMIX+9.pdf.

SEPA welcomes newly-elected officers to 2-year terms beginning 1 January, 2017: President-Elect James Albury, Secretary/Treasurer Patsy Wilson, reelected, and IPS Council Representative John Hare, reelected. Continuing officers include: Derek Demeter, who will move from president-elect to president, and Ken Brandt, who will move from president to past-president.

For membership applications, activities, and other SEPA events, visit the website at www.sepadomes.org.
SUPERVOLCANOES

Winner
Best Immersive Fulldome
Jackson Hole Wildlife Film Festival 2013

Award Winner
South Korean Planetarium Festival 2012

Award Winner
Jena Fulldome Film Festival 2013
I recently presented a workshop called “Flip Your Dome” for the Middle Atlantic Planetarium Society and also for the Great Lakes Planetarium Association. The first premise of this workshop was to jolt the participants out of their comfortable Northern Hemisphere bias to simulate what many in our audiences experience: confusion.

We are so familiar with our home sky that we sometimes rush what we are presenting because we know it so well. Many of us monitor the audience knowledge and what they are experiencing by keeping the presentation live and interactive, but in many cases I have witnessed presenters making assumptions about the audiences’ understanding based on their own extensive knowledge.

So we explored a way to turn things upside down, to refresh lessons for us: we went to the Southern Hemisphere sky and felt the cognitive disconnect of viewing the sky from a different perspective. We discussed strategies we need to remember with first time visitors to our planetariums:

- Take time to let the audience observe and comment on their observations.
- Transition between observations deliberately and move the pointer slowly so that the audience can absorb what they are seeing.

Then we thought about how we can set up unique scenarios that challenge students to be more observant, solve problems, and demonstrate that they have a real working knowledge of the topics we are teaching. We can ask them to observe the same phenomena at different latitudes, transitioning slowly and smoothly between latitudes, and have them share explanations of why things look so different.

**Reversing lefts and rights**

The sun and moon still rise from the east, but when looking north from the Southern Hemisphere, they rise and appear to move from right to left, rather than left to right. (How would we record that? We would need to revise our worksheets that are created for the Northern Hemisphere.) The seasons are different at different latitudes; sometimes they are opposite to our own. And the moon phases are on the opposite side! Many constellations look up-side-down and there are new constellations. The Southern Cross moves clockwise!

Patty Seaton (Prince George’s County Public Schools in Upper Marlboro, Maryland) explained how she flips her dome to challenge fifth grade students. She said that after talking about the moon’s phases at 40 degrees north, she shows the students a first quarter moon in the early evening sky and has them describe it to her. (They say it looks like a letter D.) Then she shows the same moon at 40 degrees south and has them notice that it looks like a backward D. They need to be able to explain what is the same about these moons (they are both facing the source of light) and note that what we see just depends on the position of the observer on the Earth.

How else can you “Flip Your Dome”? Why not share new sky stories, especially about the Southern Cross and the “dark constellations.” For an example, see “Fire and the Pointers,” as related by Paul Curnow, a planetarian from Adelaide, Australia, at the right.

Paul is an excellent resource for information about Australian and New Zealand Aboriginal traditions and astronomy. Look for some videos of him on YouTube; you can contact him at starmanzone@adam.com.au

If you Google “Australian Aboriginal Astronom y you can read about some dark constellations. This site tells us that “Many Aboriginal groups have stories about the “Coalsack”—the famous dark cloud next to the Southern Cross. Some see it as the head of a lawman, or a possum in a tree, but many groups tell stories of a great emu whose head is the Coalsack, and whose neck, body, and legs are formed from dust lanes stretching across the Milky Way.”

www.emudreaming.com/Examples/emu.htm and kamilaroianationsidentity.weebly.com/ the-dreaming.html

On the other hand, the dark constellations of the Incas include a shepherd, a fox, two llamas, a partridge, a toad and a serpent. futurism.com/the-dark-constellations-of-the-incas

You also can talk about how constellations of different cultures reflect the political system and geography for the time and the
Voices From the Dome: Use no visuals, just the sky and voices from colleagues around the world! To find out more go to: www.ips-planetarium.org/?page=audio.

For a real flip, turn your dome over to someone from another country through the Week in the United States project. Look here to find out how: www.ips-planetarium.org/?page=share.

I am sure that you can think of many more ways to “Flip Your Dome.” I encourage you to share your ideas with me and I will pass them on!

• To make a simple “Crux Clock,” you can find Michael Smith’s kit at users.hunterlink.net.au/~madms/cruxstuff.html.
• To determine the date and time using the Southern Cross, go to maas.museum/observations/2010/08/04/using-the-southern-cross-to-find-the-date-or-the-time
• Finding the South Pole: maas.museum/observations/2013/01/23/finding-south-using-the-southern-cross

It is said that you colleagues from the Southern Hemisphere are better able to be bilingual about the Northern and Southern skies because most sky maps and stories are biased toward the Northern Hemisphere and you have to revise them all the time. Perhaps though you can “Flip your Dome” for your students too. By using the Northern Hemisphere stars and having them explain what they see and why, you may help them to develop a deeper understanding of the concepts as well.

Really small video projector:
I spotted the tiny Sony MP-CL1 at IPS this year and thought “what a perfect device for analog portable planetariums!” It is low cost and the resolution is great; it currently sells for about $350 on Amazon.

Specifics: 1920x720p HD resolution, less than a half inch thick and about the size of a phone. HDMI input with MHL support for streaming, runs up to about 2 hours on a charge, with wireless capability built in. No focusing is required. Built-in 1 watt speaker. Recharges from standard USB. www.projectorreviews.com/sony/sony-mp-cl1-laser-projector-review-specifications.

Audio amplification systems
Here are some current suggestions, made by colleagues, for saving your voice under the dome with some quality systems.

Travelling telescope and planetarium in Africa
During IPS 2016 I was delighted when Dave Weinrich introduced me to a new colleague, Susan Murabana, from Nairobi, Kenya. (Also see Joanne Young’s President’s Message on page 6.) She is a powerhouse of energy and her enthusiasm is contagious. She is managing director of The Travelling Telescope Africa Ltd.

As you can read on the web, “The Travelling Telescope Africa Ltd. is a company now based in Kenya dedicated to promoting science and technology using astronomy tools and concepts. We are a team of astronomers and our staff comprises astronomy outreach professionals and astronomy graduates from the University of Nairobi. Our main tools include a state-of-the-art digital mobile planetarium, Kenya’s largest telescope, and various hands-on tools and software.”

The group is passionate about school visits, both government and private, and public events, from city groups to remote lodges. “We aim to be sustainable by using revenue generated from tourism to enable us to do free or heavily discounted events in schools.”

To learn news of her exciting work and adventures, read Susan’s blog: medium.com/@TravelTelescope. Photo by Susan Button.
**Equals Mars excitement**

NASA announced via press release in July that the Museum of Science in Boston has received a $912,000 award that will enable it to capture the excitement of the next generation’s moonshot—the human journey to Mars and back.

“NASA is closer to sending American astronauts to Mars than at any point in our history,” said NASA Administrator Charles Bolden in 2015.

The agency is again calling on the Museum of Science to educate the public about a critical topic on the national agenda. The two-year grant supports From Project Mercury to Planet Mars: Introducing Engineering and Inspiring Youth through Humanity’s Greatest Adventure. The Museum will create two educational experiences that will bring to life this historic pioneering endeavor:

- A dynamic immersive fulldome planetarium show engaging audiences in the vast engineering challenges, revolutionary technological solutions, and desolate beauty of a journey to the red planet; and
- A large-scale, hands-on challenge introducing visitors to the engineering design process by building, testing, and improving a solution to a unique Mars exploration problem.

The Museum was one of nine informal education organizations chosen from 73 applications through a peer-reviewed process for NASA’s almost-$10 million Competitive Program for Science Museums, Planetariums and NASA Visitor Centers Plus Other Opportunities award. (See more about the award on page 48.)

The museum has worked with NASA and other museums and universities on many projects, including:

- From Dream to Discovery: Inside NASA planetarium show;
- Three out-of-school time (OST) curriculum units integrating planetary science with technology and engineering;
- Evaluating NASA’s Space and Earth Informal STEM Education collaboration to raise the capacity of museums and informal science educators to engage the public in heliophysics, earth science, planetary science, and astrophysics;
- Developing the Star Wars: Where Science Meets Imagination exhibition.

Visit the MOS at www.mos.org.

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**Books about astronomy for 5- to 7-year olds**

Recently I posted a question on Facebook, asking “What are your favorite books for 5- to 7-year-old children?” I received some good replies that I would like to pass along. If you can tell me of some more, I will add them to my list.

National Geographic Jump Into Science books are always good (Steve Tomecek is a friend and a wonderful author; and the books are nicely illustrated). His titles include Sun (2016), Moon (2008), and Stars (2006). Another good book is the National Geographic Kids First Big Book of Space by Catherine D. Hughes (2012). There are also many National Geographic “beginning reader” books about astronomy and other science topics that children might enjoy reading themselves.

There’s No Place like Space: All About Our Solar System (Cat in the Hat’s Learning Library) by Tish Rabe, 1999.


Switch on the Night by Ray Bradbury, 2004. A lonely little boy who is scared of the dark sits in his room alone, with only light for company, until a little girl named Dark appears and shows him that light switches don’t just switch off the light—they switch on the night. And to switch on the night is to switch on the stars, the moon, the crickets, and the frogs.


There is even an Italian book that I can recommend that was co-authored by our friend and colleague, Simonetta Ercoli! It is Io, mamma, papà e le stelle (I, Mamma, Papa, and the Stars), co-written with Walter Risolo and Simonetta Ercoli, 2015, and illustrated by Francesca Graziano.

A second book was set to be published this October. I look forward to reading it!

—Susan Button

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**Loss of colleagues**

I must tell you all that one of our portable planetarium cheerleaders, inventors, and champion problem solvers passed away in September. This is especially distressing to me as he was a very dear friend. Please see a few comments about the impact that this wonderful man, Ray Worthy, had on the planetarium community on page 97.

Another loss that I especially feel is George Reed; he was another talented, generous, caring man and a wonderful artist. George is responsible for translating my vision of travelling around the world with my portable dome strapped to my van into a logo, especially for me, that I have used for over two decades! See a tribute to George, on page 98.

Thank you Ray and George for being a big part of my life; rest in peace.☆
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Vicki Amorosi
Vice President
Magna-Tech Electronic Company

MTE proudly serves as the exclusive North American distributor of Konica Minolta Planetarium systems.
Road Atlas for the Total Solar Eclipse of 2017
Reviewed by Francine Jackson, URI Planetarium, Rhode Island, USA.
As a follow-up to Fred Espenak’s Total Solar Eclipse 2017 August 21, his Road Atlas takes the maps in the previous book and magnifies them, showing each section in much greater detail. The entire path of totality is broken up into approximately 50-mile increments, with the local time and duration of totality for one spot on the central line. In addition, on either side of the central line, he marks the decreasing times up until the northern and southern boundaries. For example, a resident in Idaho Falls who doesn’t desire to travel to the central line for 2 minutes and 18 seconds of totality can stay in the back yard and witness 1 minute and 40 seconds.
Now, armed with this Road Atlas, plus Espenak’s two others, all we need to enjoy the first total solar eclipse in the continental U.S. in decades is good weather. Too bad the author can’t help with that.

The Man Who Painted the Universe: The Story of a Planetarium in the Heart of the North Woods
Reviewed by Francine Jackson, University of Rhode Island Planetarium, Rhode Island, USA.
How often do we begin a dream project, only to realize the possibly staggering amount of work and dedication necessary to achieve it would be beyond the limits of our abilities? Unfortunately, for many of us, our “best laid plans” often overwhelm us, and we just let them slide into what might have been.
Not so with Frank Kovac. When he was a child, a family trip to Chicago’s Adler Planetarium began a life-long dream of having his own stars. At first he was content with creating a beautiful mural on his bedroom wall, then building his own Mud Creek Observatory. But his site in the North Woods of Wisconsin, although fairly dark, was also very cloudy. Then he realized that he really wanted his own planetarium. And he would build it, virtually alone. From design concept to implementation, every nail, every part of the structure was of his own making.
The Man Who Painted the Universe is the story of Kovac’s decades of building his dream: Where to put it; what it would look like; how he would depict the stars; the many times his design had to be reviewed, and, of course, how to pay for it. During his time, Kovac continued to maintain a full-time job, just to cover the more than $100,000 price tag of what certainly some folks might have thought of as Frank’s Folly.
But he did it: The Frank Kovac Sr. Planetarium is open to the public daily, and has many groups requesting shows in his beautiful facility. Kovac has added exhibit space, and he makes sure all of the shows he presents—yes, they’re all live—conform to the individual audience. The Kovac Planetarium is located in a not-easy-to-access location in upper Wisconsin, but after reading this book and learning what one man accomplished just by keeping his dream alive, everyone in the field should seriously think about visiting with Frank Kovac and marveling at the beauty of his workmanship. The Man Who Painted the Universe is very short, only 120 pages, but it is a book that should make all of us consider how, with enough perseverance, we can do anything we desire. Don’t pass up this book.

Star Struck: Seeing the Creator in the Wonders of Our Cosmos
Dr. David Bradstreet and Steve Rabey, Zondervan, Grand Rapids, Michigan, 2016
Reviewed by Francine Jackson, University of Rhode Island Planetarium, Rhode Island, USA.
In the minds of many people it seems that to be a scientist, you must be an atheist—that is, there can’t be any correlation between science and theology. I’m sure, then, that it can be very surprising for members of the public to learn that there are scientists who grasp the two disciplines as being complementary. For example, with many astronomers the belief is that God made the universe, but He gave us the job of figuring out how He did it. Dr. David Bradstreet and Steve Rabey more or less introduce this idea in Star Struck. They knit the wonders of the heavens with Biblical context in order to remind us that there is so much more to the universe than we will ever be able to grasp, even beginning with the many and varied theories of creation.

From everything having existed forever, to God creating “the heavens and the Earth (Genesis 1),” to any other form of existence, the authors see a divine hand in the making. And, yes, they sure make a good argument for it.

Their parallels of sometimes unknown circumstances between the science and religious communities also make the two very real. As an example: Many of us were unaware that Astronaut Buzz Aldrin’s partaking of Communion while in the Eagle capsule on the moon (Continues on page 98)
GOTO Gets Ready!

Since our founder Seito Goto filmed a total solar eclipse in Japan in 1936, GOTO INC has been fascinated by eclipses. Today, as millions of Americans prepare for the 2017 eclipse, the country’s planetariums are acting as important resources for their communities. Curious and eager audiences are flocking to local school and public programs to learn about moon phases, solar science, eye safety, and the history and cultural importance of eclipses. The months leading up to a total solar eclipse are perhaps astronomy’s most “teachable moments.”

Here are a few examples of the ways GOTO INC is helping to bring the eclipse to America:

**Installed Model: CHRONOS II HYBRID**

They are using the precise positions and motions of their GOTO CHRONOS II HYBRID’s sun, moon, and planets to teach K-12 students about the eclipse. Planetarium director Paul Zeleski says, “Since we’re about 97% eclipsed here, I plan to do some public outreach in Gillette with solar telescopes and some planetarium presentations to get people informed and then get them down to Casper for the main event.”

**Installed Model: CHIRON HYBRID**

Planetarium director Derrick Rohl says, “Our activities build up to a 3-day Eclipse Science Festival we’ll be hosting on eclipse weekend here in Music City. … and our CHIRON projector is still looking as stunning as the day we opened. Not only do we use the CHIRON HYBRID system for pre-produced content like our new “ECLIPSE: The Sun Revealed” show, but we also use the system’s realtime features 363 days a year to show off the night sky in “Skies Over Nashville.”

**Installed Model: GSS-CHRONOS**

(The world’s first CHRONOS site) is planning for its moment in the shadow with programs director Steve Morgan says, “…include a live-narrated segment focusing on local eclipse circumstances and information. The CHRONOS is useful for teaching about moon phases and showing the motion of the Moon in its orbit. We also can run the CHRONOS to the time of the eclipse and show the position of the planets and brighter stars in the sky in relation to the eclipsed Sun’s position.”

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Space Science Exhibits for STEM and STEAM Part 2- What next?

In the previous Sound Advice we outlined a process for how to develop electronic STEM- and STEAM-based exhibits. In the planetarium world we see many of these being added in lobbies, queuing areas, etc. In this installment we’ll look some methods in implementing your terrific idea. In addition to discussing content, we listed some of the possible electronics that might be a part of the design.

Where do we put the electronics?

Now that your creative content and storyline approaches are worked out the next important question is technical. There are a couple of approaches to where you put the equipment and how it is wired, controlled, maintained, and updated.

Of course any projectors, touchscreens, and audio speakers will be located in/at the exhibit, so today we address where to install the other necessary items. Table 1 below summarizes advantages and disadvantages to each method.

- **Local.** In this approach the audio/video/power conditioning electronics go right at the exhibit location inside a wallbox, case work, faux rock, or other hiding place. The advantage here is that this approach is lower cost to install since you don’t need to run conduits for wiring to this location.

- **Central Control Room (CR).** In this method, the media players, computers, audio players, audio processors, switchers, etc. are installed in racks in a central equipment room. There are many advantages to this design in that it allows the actual exhibit to be very small and clean in appearance. It is easy for a master control system to turn all the exhibits on and off at scheduled times.

  - In large scale installations might need less conduit and infrastructure than a Central CR approach.
  - Reduces “economy of scale.” Requires more units of hardware, racks, UPS, etc.

  - Most of the heat and fan noise are isolated out of exhibit areas.
  - Most of the heat and fan noise are isolated out of exhibit areas.

  - Can troubleshoot most equipment behind closed doors.

  - Can troubleshoot most equipment behind closed doors.

  - Economy of scale. Can best use $$ invested in multichannel amps, switchers, UPS, etc.

- **Distributed.** When exhibits are scattered across multiple floors or buildings, a combination of a central control room supported by smaller racks closer to each exhibit area can be great solution. The little “subsystem” racks are fitted into data closets (IDF in the IT world) or even inside larger casework and house the gadgets for several nearby exhibits.

  - Need to aggressively ventilate the structure.

  - Need to use audio and video extenders to assure performance.

  - Not useful for KVM monitoring.

Table 1. Read the above text first!

<table>
<thead>
<tr>
<th>Advantages</th>
<th>Central CR Technology</th>
<th>Distributed Technology</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lower cost of infrastructure. Little or no conduits. Only need power locally in the exhibit.</td>
<td>Allows smaller, trimmer, cleaner exhibits and wireways.</td>
<td>In large scale installations might need less conduit and infrastructure than a Central CR approach.</td>
</tr>
<tr>
<td>Good when there are very few exhibits.</td>
<td>Better when there are many exhibits.</td>
<td>The right choice when the exhibits are scattered on multiple floors or levels.</td>
</tr>
<tr>
<td>Most of the heat and fan noise are isolated out of exhibit areas.</td>
<td>Most of the heat and fan noise are isolated out of exhibit areas.</td>
<td></td>
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<tr>
<td>Can troubleshoot most equipment behind closed doors.</td>
<td>Can troubleshoot most equipment behind closed doors.</td>
<td></td>
</tr>
<tr>
<td>Economy of scale. Can best use $$ invested in multichannel amps, switchers, UPS, etc.</td>
<td>Allows KVM monitoring/updating of all exhibits at one location.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Disadvantages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reduces “economy of scale.” Requires more units of hardware, racks, UPS, etc.</td>
</tr>
<tr>
<td>Harder to maintain and control many little locations. Troubleshooting interrupts visitor areas.</td>
</tr>
<tr>
<td>Need to aggressively ventilate the structure.</td>
</tr>
</tbody>
</table>
es of a central control room but without the high cost of long runs of individual conduits to each exhibit. We call these home runs. In this approach each of the scattered racks are connected by one main conduit so the master control system can still turn on-off all the exhibits at a scheduled time.

**Executive Summary:** So, as general guideline:

- **Local.** If you have very few exhibits or a slim budget.
- **Central Control Room.** The best for a site with many exhibits that are within 100m or closer of the control room and with a good solid budget and when you want to KVM monitor all the systems.
- **Distributed.** Best solution when some of the exhibits are clustered in various areas far from a central control room.

Want more? Email me directly and I’ll send a detailed PowerPoint that drills down deep into this subject.

**Next Issue:** Adding low cost, effective distance learning to domes.

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Throughout Earth’s violent history, impacts from comets and asteroids have mercilessly shaped its surface.

The ancient barrage continues today: from harmless meteors – those brilliant streaks in the night sky, to mountain sized boulders wandering perilously close to Earth.

Terrifying and majestic, these invaders from space are capable of utter destruction yet they have delivered life-giving water and most of the organic materials necessary for life.

Life on Earth owes its very existence to these denizens of the solar system, yet it could all be wiped out in an instant.

This ceaseless Firefall is our only tangible connection to the universe beyond and is an ever-present reminder of our own humble beginnings in the hostile environment of space.

It’s not a matter of if, it’s a matter of when...

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A note from a new friend
Hello Planetarian readers!
My name is Neil Schneider, and I serve as Executive Director of The Immersive Technology Alliance (the ITA). In more ways than one, planetariums continue to wow audiences with awe-inspiring experiences that are truly immersive by making us forget the world around us.

I remember as a child I fidgeted in my seat looking forward to the surprise the local science centre had in store for me. Whether it’s a galactic outlook or an exploration of our own habitat, planetariums continue to impress.

I’m reaching out because I think that the excitement and enthusiasm behind planetariums are very similar to that found with other forms of immersive media like augmented and virtual reality. Charlie Morrow, Chairman of the IPS Immersive Sound Committee, approached me wondering if there are ways for our organizations to work together, and I think there are.

The ITA was founded to help build the viability of immersive technologies like virtual and augmented reality. We achieve this through problem solving working groups, we hold international industry-building events, and we generate public awareness so others can share in the excitement for the technologies we all hold dear. I’m hoping that there could be an exchange of expertise that could help grow both our markets.

Feel free to learn more about our work at www.ita3D.com. If you have interests in virtual and augmented reality and want to learn more, email me at neils@ita3D.com and I can address them in a follow-up article in a future Planetarian issue.

Neil Schneider, Executive Director
The Immersive Technology Alliance

NASA unveils public web portal for research results
Public access to NASA-funded research data now is just a click away, with the launch of a new agency public access portal. The creation of the NASA-Funded Research Results portal on NASA.gov reflects the agency’s ongoing commitment to providing broad public access to science data.

NASA Deputy Administrator Dava Newman said “Through open access and innovation we invite the global community to join us in exploring Earth, air and space.”

NASA now requires articles in peer-reviewed scholarly journals and papers in juried conference proceedings be publicly accessible via the agency’s PubSpace: www.nihms.nih.gov/db/sub.cgi.

PubSpace is an archive of original science journal articles produced by NASA-funded research and available online without a fee. The data will be available for download, reading and analysis within one year of publication. For more information, visit: www.nasa.gov/open/researchaccess.

Atom Club gets kids interested in STEM
In Dorset, England, an “Atom Club” was founded earlier this year, with the aim of encouraging more 6- to 14-year olds to get into science, technology, engineering and maths (STEM for short). It is a non-profit organisation, using sales of their fun subscription boxes to fund after-school clubs and a mobile planetarium.

After a successful crowdfunding campaign in June, the start-up has subscribers from all across the UK and has recently taken delivery of their very own mobile planetarium. This inflatable dome immerses the children in 360 degree video taking them on a tour of the solar system, the oceans, and even the human body. The plan is to take the dome, along with other great demonstrations, to schools all across Dorset and Somerset.

The cost of the dome itself was donated by Dorset based Morning Data Ltd, a global insurance software provider, and the projection system was donated by the club’s sister company The Honest Agency, BVM’s Start-up Business of the Year 2015.

Chris Ryu, founder of the Atom Club said, “Planetariums are able to inspire children like nothing else. Schools love them, but unfortunately they cost a lot to hire, on average around £450 per day. The very generous donation by Morning Data allowed us to achieve this great milestone much earlier than we ever thought possible.”

Read more at www.blackmorevale.co.uk/free-planetarium-will-debut-at-marnhull-fest/story-29509352-detail/story.html#k8CtzeCSO7b6hYqm.99.

By Jackie Spiteri, Blackmore Vale Magazine
Stalbridge, Dorset

Reprinted with permission

Stumbled across on Amazon: The Complete Space Buff’s Bucket List by Loretta Hall. Of course it talks about the usual things like great museums, planetariums, astronauts, space suits, rockets, planets, and stars. But it also has duct tape, Tang, Cosmos, movies, space burial, Astronaut Ice Cream, Biosphere, aliens, and Meteor Crater.

Each Bucket List book (there are now four) is dedicated to an appropriate non-profit and this book highlights The National Space Society. If you have things on your bucket list that are not in this book, no fear, because there is a blank list in the back of the book. Published by Rio Grande Books, 2016, 128 pages.
Raymond Worthy

We were very saddened to learn about the passing of our dynamic colleague, Ray, on September 5, 2016. He was 84 years old. His kind spirit, excellent storytelling and generous assistance to colleagues in the planetarium community will be greatly missed.

Ray started building his own planetarium in the early 1980’s. His own words tell about the very beginning of his need for a portable planetarium as an educator. He related, “In the early nineteen eighties, we, who lived on the east coast of England suffered a spring and early summer, when for a period of about six weeks, a flat layer of slate gray stratus cloud covered the sky. Imagine going six weeks of not seeing the Sun. This may have been depressing in the normal way, but when one was a student who needed to run some continuous astronomical observations for a practical examination, then it became a calamity.”

“I determined that, by the following year, I would have my own planetarium. At the time, there was no thought of running a business. The planetarium was simply an education tool par excellence. Once I could see that the projector was going to work, I turned my attention to the construction of a dome. I decided on one, which could be inflated and put away in storage, as the occasion demanded.”

So after he built his own projector, the dome came next. After many experimental domes, produced by hand with the help and sewing skill of his supportive wife, Josie, his innovative dome design became so popular that he started his own company, Stargazer Planetariums UK Limited, to produce domes for sale!

Dr. Jenny Shipway, British Planetarium Association past president, reports, “Ray had a huge impact on the planetaria in the UK and worldwide; he was the first to design, create and deliver a planetarium in the UK as a full-time planetarian. He produced these designs for planetarians worldwide, giving advice and support for their use, and leading the way for the many of us who now use these to inspire millions of children (and adults!) each year.

“He also supported fixed planetaria, notably through his involvement with the creation of Wynyard Planetarium near Stockton-on-Tees. Ray was made a fellow of IPS in 2008, and received the British Association of Planetaria’s Lifetime Achievement Award in 2009. Although his poor sight meant he had to retire from active planetarium work in recent years, his planetarium design was passed on to Richard Lake who continues their production.”

Throughout his lifetime Ray genuinely enjoyed teaching and relating his experiences to other educators. As he learned about building planetariums he freely shared that knowledge with everyone who had a question or a problem. Luckily, through the encouragement of colleagues and his family, many of his stories and discoveries have been preserved as articles and audio files so that no one needs to “reinvent the wheel.”

He was a founding member of the Home Planetarium Association; to read Ray’s articles for them contact Gary Likert at mrgare5050@gmail.com. He also wrote a column for the Observatory Central; to read this column contact Ron Walker at www.observatorycentral.com. Ray also recorded a series of podcasts reminiscing about his history of astronomy education. A few unedited versions can be found at archive.org/details/Podcast2SavedByTheStarsV2. Through his own words we can still enjoy his very special observations about human nature; solutions to the technology of building portable planetariums and his creativity, imagination and enthusiastic zest for living can be passed along to new generations of planetarians.

—Submitted by Susan Button

Join IPS at the IMERSA Summit in Denver, February 22-26, 2017

The 8th annual IMERSA Summit will be held at the Denver Museum of Nature and Science on February 22-26, 2017.

The yearly gathering continues conversations between converging business sectors and shaping the immersive arts industry with fulldome and VR film showcases, innovation sessions, networking sessions, and more.

Dr. Mark SubbaRao, IPS Chair of the Science and Data Visualization Task Force, will be representing IPS in Science Matters: Accuracy in Immersion.

Preliminary session description: A majority of immersive domes exist in museums and science centers, so accuracy of the information presented in fulldome shows is extremely important to the mission of the institutions who exhibit the shows. The balance between accuracy and portraying scientific concepts that are understandable and accessible to the general public is often a creative challenge. We will explore the challenges and solutions with an engaging panel of experts who face these issues on a regular basis.

Charlie Morrow, IPS Chair of Immersive Audio Committee will be representing IPS in Technology Matters: Calibration and Demonstrations.

Preliminary session description: There is a lot of technology that has to come together to create a successful immersive dome experience. We will explore key components of the technology including video projectors, audio, video playback, and real time simulation software and demonstrate with a focus on integration, engineering, measurement guidelines and optimizing the capabilities of the state-of-the-art in technology.

Go to IMERSA.org to register and for complete details.

Jean-Michel Faidit is pleased to announce the publication of his 10th book, Mairan and the first theories of the aurora borealis, by Presses du Midi. After the mini ice age of Louis XIV, the sun experiences a resurgence of activity. The northern lights are becoming frequent and intense, stimulating scientific debate in the Enlightenment. Mathematician, astronomer, and geophysicist Jean-Jacques Dortous Mairan (1678-1771), was among the scientists of the time studying the phenomenon.

Jean-Michel Faidit

Ray Worthy

December 2016

Planetarian
Dr. George Reed
March 8, 1939-August 2, 2016

After a long battle with Alzheimer’s, Dr. George Reed passed away on August 2, 2016, leaving behind his wife of 53 years, Joan; three children, and five grandchildren.

Dr. Reed believed that “Everything is related to Astronomy” and spent his life inspiring students and the general public to share his love of naked-eye astronomy and the history of astronomy. He was a beloved professor who made the subject come alive for so many during his 29 years teaching at West Chester University in Pennsylvania.

In addition to teaching, Reed was the director of Worldwide Planetarium Sales for Spitz, Inc. in Chadds Ford, Pennsylvania, from 1986-2000. He was the co-director and then director of the Spitz-West Chester University Summer Institute in Planetarium Education from 1972-1995. He helped teachers from around the globe learn to incorporate the planetarium into their curriculum to further enhance the teaching of astronomy and the night sky.

A cartoonist as well, Reed’s art has been seen in innumerable planetarium shows for the general public and teaching programs in the classroom. He wrote the weekly “Naked-Eye Astronomy” column for the daily local newspaper in West Chester, Pennsylvania that ran for 18 1/2 years—956 articles in all.

This tribute was written by Tara Reed, George’s middle daughter. To read more about her father and his life, see her blog at pivottohappy.com/dads-passing.

Another wonderful article appears at wcsdvolunteers.wordpress.com/2012/02/24/georges-story, from the Washoe County School District in Reno, Nevada.

Klim Churyumov, 1937-2016

On the 80th year of life has died the world-famous scientist, astronomer Klim Churyumov. Churyumov was one of the keynote speakers at the IPS 2016 Conference in Warsaw, Poland, in June.

Churyumov was born February 19, 1937 in Nikolaev, Ukraine, the fourth of eight children of Ivan Ivanivich Churyumov and Antonina Mikhailovna Churyumova. His father was declared dead during World War II in 1942.

In 1949 Churyumov’s family moved from Mykolaiv to Kiev. After seventh grade, he entered the Kiev Railway College, graduating with honors in 1955. He received a recommendation for admission to higher education and went to study physics at Kiev University.

He began studying comets under Professor Sergey K. Vsekhsvyatski, a renowned comet researcher. He went on to research new comets alongside Svetlana Gerisamenko, making the discovery of Comet Churyumov-Gerasimenko (67P/Churyumov-Gerasimenko) in 1969.

In 1986, he discovered a second comet with Vladimir Solodovnikov, called Comet Churyumov-Solodovnikov (C/N1 1986).

Dr. Mikhail Churyumov's family moved from Mykolaiv to Kiev. After seventh grade, he entered the Kiev Railway College, graduating with honors in 1955. He received a recommendation for admission to higher education and went to study physics at Kiev University.

He began studying comets under Professor Serge K. Vsekhsvyatski, a renowned comet researcher. He went on to research new comets alongside Svetlana Gerisamenko, making the discovery of Comet Churyumov-Gerasimenko (67P/Churyumov-Gerasimenko) in 1969.

In 1986, he discovered a second comet with Vladimir Solodovnikov, called Comet Churyumov-Solodovnikov (C/N1 1986).

Comet Churyumov-Gerasimenko was selected to be the target of the European Space Agency probe Rosetta. Professor Churyumov was at ESA headquarters on 12 November 2014 when the Philae lander separated from the probe and carried out a successful landing on the surface of the comet.

In 2004 he was named director of the Kyiv (Kiev) Planetarium.

He has authored around 1,000 scientific papers as well as several popular text books. He also authored children’s prose, publishing several volumes between 1999 and 2002. His titles include The Adventures of Dino Dino and Math for Kids.

He was a member of the National Academy of Siences of Ukraine, the New York Academy of Sciences, the International Astronomical Union, the European Astronomical Union, and the Ukrainian Astronomical Association.

He was editor of the magazine Our Skies (Ukrainian: Наше Небо) in 2006-2009.

(Supplemental notes continued from page 92)

as members of his church were doing the same on Earth: “the first liquid…and the first food eaten [on the moon]…were communion elements.”

Every chapter in Star Struck is a parallel of religion within science. Their explanations are very easy to grasp, and are sure to make even the greatest disbelief who, one hopes, has a fairly open mind, realize how close astronomy and religion parallel in so many varied ways.

In addition, as book formats go, I found the notes and sources at the end very useful. This was the point where extra explanations, sources, etc., were listed, but, instead of a running set of notes, all these extras are listed by the page on which they relate. What a great idea! I was actually able to both find and understand the extra material for each notation. It would be helpful for others to adopt.

Dr. Bradstreet is known to many of us as an astronomy educator, whose alliance with Spitz has resulted in easy ways to introduce sometimes difficult concepts for students to understand. This book is a complement to his many lessons; in fact, the construct of the book, 23 very short but concise chapters, would be a great alternative to the normal astronomy text, one that would give a student a chance to realize that science is so much more than just cold facts: it is a part of the entire being, a spiritual entity that is connected to everything else.

And, we, as scientists, should take some time to read this, if only to confirm our oneness with the universe.

Klim Churyumov speaking at IPS 2016.
2016


16-18 December. Small digital planetarium workshop, Marseille Planetarium, Marseille, France. Contact: lionel.ruiz@live.fr

31 December. Deadline for entries to “Page of Stars” organized by IPS Portable Planetarium Committee in collaboration with Serafino Zani Astronomical Observatory. Contact: Susan Reynolds Button, sbuttonq2c@gmail.com; www.ips-planetarium.org/?page=pagessofstars

31 December. Deadline for the contest “A Week in United States.” For information and applications requirements go to: www.ips-planetarium.org/?page=WeekinUS

2017

22-26 February. IMERSA Summit 2017. Denver Museum of Nature & Science, Denver, Colorado, USA. Contact: info@imersa.org; www.imersa.org

28 February. 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 500 euro. www.planetari.org


April 2017. 50th anniversary, The Ward Beecher Planetarium, Youngstown, Ohio (USA). wbplanetarium.org

7-9 June. IPS Fulldome Festival Brno 2017, Brno Observatory and Planetarium, Kravi hora 2, Brno, Czech Republic. The festival is supported by the International Planetarium Society. Contact: Jiri Dusek, director@hvezdarna.cz; www.fulldomefestivalbrno.com/

22-23 April. Italian Association of Planetaria (PlanIt), XXXII National Conference, Planetarium Südtirol/Alto Adige, San Valentino in Campo 5, 39053 Cornedo all'Isonzo, Bozen, Italy. Contact: osservatorio@serafinozani.it; www.planetari.org

29 April-1 May. Gesellschaft Deutschsprachiger Planetarien e.V., (GDP), Annual meeting of the German-Speaking Planetaria, Berlin. All three planetaria (Zeiss-Grossplanetarium; Wilhelm-Forster-Sternwarte; Archenhold-Sternwarte) will host parts of the conference. www.gdp-planetarium.org


17-20 May. 11th Annual FullDome Festival in Jena, Zeiss-Planetarium, Germany. Contact: info@fulldome-festival.de or Volkmar Schorcht, schorcht@zeiss.de; www.fulldome-festival.de

18 May. International Museums Day, icom.museum

21 August, Total solar eclipse (USA).

1-3 September. Nordic Planetarium Association Meeting, Vattenhallen Science Center, Lund University, Sweden. Contact: Aase Roland Jacobsen, aase.jacobsen@sm.au.dk

15 September. Deadline for the applicants of "A Week in Italy for an American Planetarium Operator", in collaboration with IPS Portable Planetarium Committee. http://www.astrofilibresciani.it/Planetari/Week_in_Italy/Week_Italy.htm


2018

11 March. International Day of Planetaria, special event on the work of mobile domes. Contact: buttonq2c@gmail.com

International Planetarium Society Council Meeting, Toulouse, France.

21-6 July. 24th International Planetarium Society Conference, Cité de l’Espace, Toulouse, France. Contact: Marc Moutin, m.moutin@cite-espace.com

9-14 July. ESOF, Euro Science Open Forum, Cité de l’Espace, Toulouse, France. Contact: Marc Moutin, m.moutin@cite-espace.com

31 July. Deadline for the applicants of "A Week in Italy for an American Planetarium Operator", in collaboration with IPS Portable Planetarium Committee. http://www.astrofilibresciani.it/Planetari/Week_in_Italy/Week_Italy.htm

For corrections and new information for the Calendar of Events, please send a message to Loris Ramponi at osservatorio@serafinozani.it More details about several of these upcoming events is included in the International News column in this issue.

The most up-to-date information also is available online at the IPS Calendar of Events at www.ips-planetarium.org

How to organize an eco-friendly planetarium conference: www.scienzagiovanissimi.it/best-practices

To see more logos, go to www.astrofilibresciani.it/Planetari/Planetaria_Associations.htm
We're learning the tricks and treats of our new Spitz SciDome system here at Fernbank. The science center is located on the northeast side of Atlanta, Georgia, the state's sprawling capital, and we belong to the DeKalb County School System. Light pollution worsens constantly. When members of the public phone to ask if "the telescope will be open for the meteors," we send them to darker sky sites miles from the metropolitan area.

A major highway circles the city, the six-lanes-in-each-direction-nightmare-during-rush-hours known locally as 285. Any small traffic mishap on it turns into huge delays.

Needless to say, any traffic snarl upsets our planetarium lesson schedule for visiting school groups, as well as all the other classes offered that day. A program for high school students that meets every morning from 8 to 11 AM is particularly tricky, as are the "experience" lessons that have two instructors dividing a school group and teaching different content.

My office mate and I teach a "Creatures of the Night and Sky" experience that begins in the planetarium. I work with the students, identifying current night sky animal constellations. Then the group divides into two sections—one stays for work on how the human eye works at night using paper and dark colored crayons, and the other goes with my office mate for a discussion of nocturnal animals. The two groups then switch so that each student experiences both classes.

The nightmare route was closed!

Earlier this year, on the day the proposed fulldome system was to be demonstrated for school board members and other administration, a tractor-trailer fire on 285 had closed all north-bound lanes by 6:30 in the morning, just as the commuter rush was beginning.

One of the high school program instructors was ill, and asked my office mate to take her class that morning. The class involved a hike on a local mountain, but office-mate Cindy didn't have her hiking boots with her, and my spare pair was too large for her feet.

Cindy's schedule also indicated a "Creatures" class at 10:45 a.m. (the high school class wouldn't finish until 11), but my schedule didn't list that class. She decided that her sneakers would have to do, loaded the students into the bus and drove them to the field trip mountain.

The 10:45 group from the previous day (who forgot they were scheduled and changed their date) was re-scheduled to come at 10:45 today. Now we had two different classes scheduled in the planetarium at the same time.

Dr. Ed Albin, the other astronomer at the time, had two large out-of-county groups scheduled in the planetarium for the 9:30 lesson. But another high school instructor was stuck in traffic. Could Ed take his class?

I offered to take the 9:30 planetarium groups. If the other instructor made it through traffic to finish his assigned class, Ed could take over in the planetarium. Or he could finish grading student lab reports. Grades were, after all, due that afternoon.

In the meanwhile, our scheduler was phoning all the schools listed for the day. Were they all planning to arrive for lessons today? Yes. All said yes.

Another group is stuck

There was also a group of about 24 science coordinators arriving for a meeting that morning. Their monthly 9 a.m. meeting was scheduled at Fernbank Science Center so they could see the fulldome demo. By 9:30 most of them, including the group leader with the meeting agenda, were still stuck on 285.

And a small group from the equipment's lens manufacturing company would be arriving for the demo as well.

Spitz's Scott Huggins and Brad Rush were caught in traffic as well, and were late in arriving to fire up the demonstration. The east and west doors to the planetarium, usually used for students entering and exiting the dome, were partially or completely blocked with projectors and equipment. Students would enter and exit through the east door only.

But for some reason, one of the two projectors wouldn't power up for the demo. After some troubleshooting, the problem cable was identified and a replacement was draped through the southwest section of seats, substituting for the non-working cable that had been neatly threaded through and taped down for safety.

Students would be arriving any minute for the 9:30 lesson. Would it be possible to test the demo with students in the theater? Unfortunately not.

Remember 285? There were no students here at 9:30, but the coordinators—half of them, anyway—were at the east door, ready to see the demo. A call from a re-scheduled school indicated they're not coming. The bus can't get through.

The coordinators entered the theater, one school board member out of five arrives, and our director begins introducing Scott and Brad. From the console, I notice that (1) Scott is nearly hoarse from several days of demos—he needs a microphone and a laser pointer, and (2) Brad appears to be typing rather quickly at the computer controls.

Now we're back to 2005

It seems that the computer system had somehow reset itself to the year 2005 and refused to recognize the site license. Scott smoothly continued his introduction until Brad had the system functioning properly, the demo commenced, and all went well. After a few questions from the audience, the coordinators and board member squeezed out the west door.

At 10:50 a.m. the large groups scheduled for the 9:30 lesson finally arrived, along with the 24 students for Creatures of the Night and Sky, all of whom managed to get through the east door with no damage to students or equipment. After enthusiastic participation during the planetarium lesson, the Creatures class went off with Cindy—who'd returned safely from the field trip—for their nocturnal animal discussion. It's a small enough group that all the students fit into Cindy's classroom.

I reset the theater sky and set up crayons and paper in a fast turn-around for their group. But the teacher decided that there was not enough time for both animals and the human eye, so after Cindy's class they boarded their bus and left. The theater was cleaned up and reset for the fourth time that morning.

Which gave the four members from the lens manufacturing company, who braved 285, their own private demo.

True story.

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