

Embracing the Tools to Connect in Virtual Environments

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Abstract. Throughout 2019—up to a full year before the onset of the COVID-19 pandemic and the global shift to virtual learning—the Smithsonian Astrophysical Observatory’s Fred Lawrence Whipple Observatory (part of the Center for Astrophysics | Harvard and Smithsonian) quietly launched its virtual in-classroom learning program, increased its social media presence with livestreams and video, and laid out a strategy for reaching the schools, kids, and adults who couldn’t get to the Observatory, whether they lived on the other side of Southern Arizona’s border patrol checkpoints, or the other side of the country. These programs and plans provided a foundation for a near-seamless transition to successful virtual programming through social media resources beginning in March 2020, including the premiere of Nationwide Livestream Star Party in April 2020—with audience estimates up to 5,000 worldwide on the first night—which was produced in conjunction with multiple other institutions and astronomers. Mt Lemmon SkyCenter, in the wake of the pandemic, immediately set to work creating video and other digital resources for learning, a direction in which they were already headed prior to the closure of onsite programming. The 2019 and 2020 learnings from Whipple Observatory and Mt. Lemmon SkyCenter provide a case study for success in virtual engagement both within and outside of the pandemic, and a roadmap to success for informal science education organizations seeking to increase their own connections in virtual environments. This paper offers additional and updated support and background for remarks made during the 2020 annual conference of the Astronomical Society of the Pacific, and is not meant to an all-inclusive discussion of available solutions.

1. The Importance of Virtual Connections in Informal Science Education

As early as 2000, researchers in formal and informal education recognized the criticality of the rapidly developing virtual engagement environment. Pierre Dillenbourg, Daniel Schneider, & Paraskevi Synteta (2002) identified virtual learning environments as designed information spaces that also served as social spaces where “users are inside the information space and see a representation of themselves and/or others in the

space.” In the 20 years since, this foundational understanding of the virtual learning environment has remained steady, and Dillenbourg et al’s understanding of the future of virtual learning environments can now be viewed as nothing less than prescient. In a recent live Zoom conversation Effie Kaspalis (2021), the Senior Digital Program Officer for the Smithsonian Institution, told an internal learning group that when it comes to digital engagement, “the platforms need to reflect the people they serve,” harkening back to nearly 20 years prior. Kaspalis was speaking directly of the environments where audiences experience what cultural institutions have to offer, whether that be web sites or social media, which were in their infancy in 2002, and certainly had not taken over the engagement and learning space. The astronomical community specifically has been working towards digitized experiences for over a decade, but still largely contained within in-person environments. Planetariums, for example, are widely updated to digital and Wi-Fi-connected resources, but are experienced in person, and the primary allure of star parties remained until recently as an opportunity to look through an eyepiece and see a planet, galaxy or nebula for oneself.

Funding for digital and virtual engagement tools also has remained limited for observatories, planetariums and science centers in recent years. In 2019, a large cohort of research astronomy groups authored a white paper urging the National Science Foundation (NSF) to provide dedicated funding for online and mobile-friendly programming and outreach efforts, writing that “the astronomy community... need[s] to capitalize on positive trends in digital literacy, the increasing use of mobile devices, and a discovery space driven by social media, through the progressive development of effective online resources in astronomy education and public outreach” (Bauer et al. 2019). The limited funding for and use of online tools for informal science education created marked challenges for the astronomical community in 2020 when the COVID-19 pandemic shut down in-person learning experiences and forced the world of informal education into the virtual environment. By March 27, 2020, the 2020 Star Parties Updates from the editors of *Sky & Telescope* and other live night sky and astronomy event listings were a sea of cancellations, with few groups initially attempting to launch online events, and for good reason: few had done it, and the “how” was not common knowledge. Ten months following the beginning of the widespread pandemic in the United States, questions remained concerning the best practices, tools, and resources for launching and maintaining virtual engagement. For the Fred Lawrence Whipple Observatory and the Mt. Lemmon SkyCenter, however, the move from in-person engagement to virtual learning environments was nearly seamless.

Located in the Santa Rita Mountains in Santa Cruz County, Arizona, the Whipple Observatory traditionally provides in-person informal education experiences to ~7,000 people per year, hailing mostly from its home county and the southern geographies of nearby Pima County. These in-person experiences include in-classroom and in-library science experiences, Observatory tours, public science lectures, and public star parties at an off-site location. In early 2019, the Observatory soft-launched an experimental virtual learning program for in-classroom experiences via Join.me, a predecessor to Zoom. Throughout that year, Whipple Observatory staff and volunteers interacted regularly with students located throughout the United States, allowing the team to develop best practices for conducting Powerpoint presentations and science demonstrations live in a web conference setting. At the same time, staff launched the Observatory’s first Facebook Live events, focusing on live lessons featuring science demonstrations.

During this same timeframe, Mt. Lemmon SkyCenter was working on generating new brand awareness by learning to use social environments for daily public engagement using one distinct voice and to create a designed social learning space. Mt. Lemmon SkyCenter is located in the Catalina Mountains just north of Tucson, Arizona, serving students, residents and visitors to Tucson and mountain towns located on Mt. Lemmon. Mt. Lemmon SkyCenter's programming through early 2020 was conducted almost exclusively in person via school interactions and live public events, and SkySchool—residential on-site programs for K-12 students lasting between one and five days, Astronomer Nights—a program which allows the public to serve as a professional astronomy for up to two nights, and SkyNights—an instructor-led evening program that provides telescope viewing through professional 24 and 32-inch telescopes on Observatory grounds.

By December 2020, both Whipple Observatory and Mt. Lemmon SkyCenter had developed best practices and pathways for launching virtual engagement, simplifying the process for other institutions and informal science education practitioners to do the same. This paper explores some of the tools and resources used by Whipple Observatory and Mt. Lemmon SkyCenter between March 2020 and December 2020 to launch online engagement, and provides meaningful discussion on how others may embrace and implement the same. This paper discusses some, but not all, of the virtual engagement softwares and solutions deployed by Whipple Observatory and Mt. Lemmon SkyCenter in the first 10 months of the COVID-19 pandemic, and is not meant to be an all-inclusive discussion of available solutions, which are numerous.

2. Barriers and Resource Reliance in the Astronomical Community

At the 2020 Annual Conference of the Astronomical Society of the Pacific, which itself was held virtually, the authors posed two questions to the audience: (1) What is the biggest barrier you face in virtual engagement, and (2) What tools do you rely on to facilitate online learning? During the session, the audience was asked to make use of a Google Jamboard to record their thoughts on each question. By the time of the conference, nearly 10 months had passed since the onset of the COVID-19 pandemic, and the answers were not surprising.

What is the Biggest Barrier You Face in Virtual Engagement? When asked about the barriers they faced, respondents overwhelmingly pointed to time as the number one issue in creating meaningful astronomy education engagement. The discussion uncovered that while time has always been a concern in astronomy education, the struggle to learn new platforms and means of engagement had exacerbated the issue. Other concerns included electronic fatigue, funding, and miscellaneous audience-related concerns. These concerns point back to Bauer et al's 2019 arguments about the need for focused outreach support and funding.

What Tools Do You Rely on to Facilitate Online Learning? When asked what tool they relied on to facilitate online learning, the responses were overwhelmingly the result of societal changes following the onset of the COVID-19 pandemic, with Zoom, YouTube, and other synchronous (live at a specific time) and asynchronous (available anytime) environments for engagement.

These audience insights set the stage for a meaningful discussion and workshop focused on embracing the tools for online engagement with hacks for making them

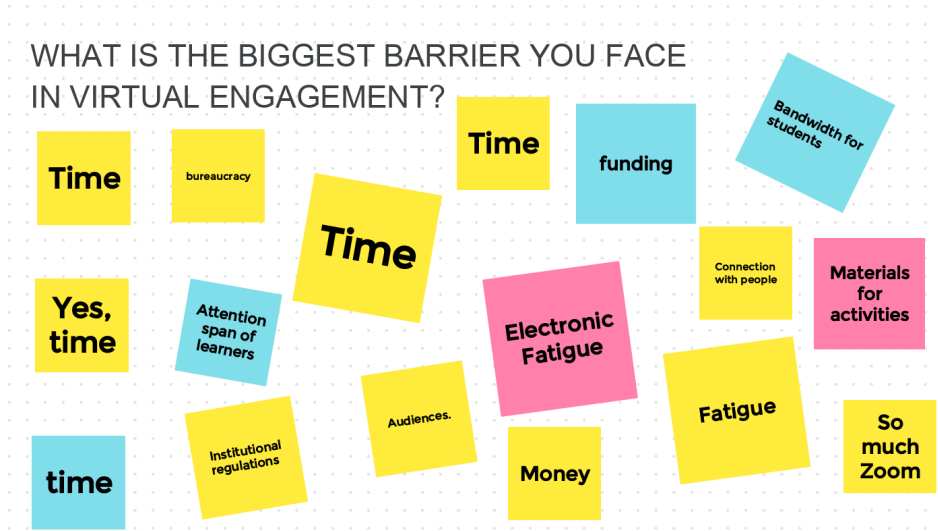


Figure 1. A snapshot of the Google Jamboard for “What is the biggest barrier you face in virtual engagement?” filled in by some audience members at the 2020 annual conference of the Astronomical Society of the Pacific.

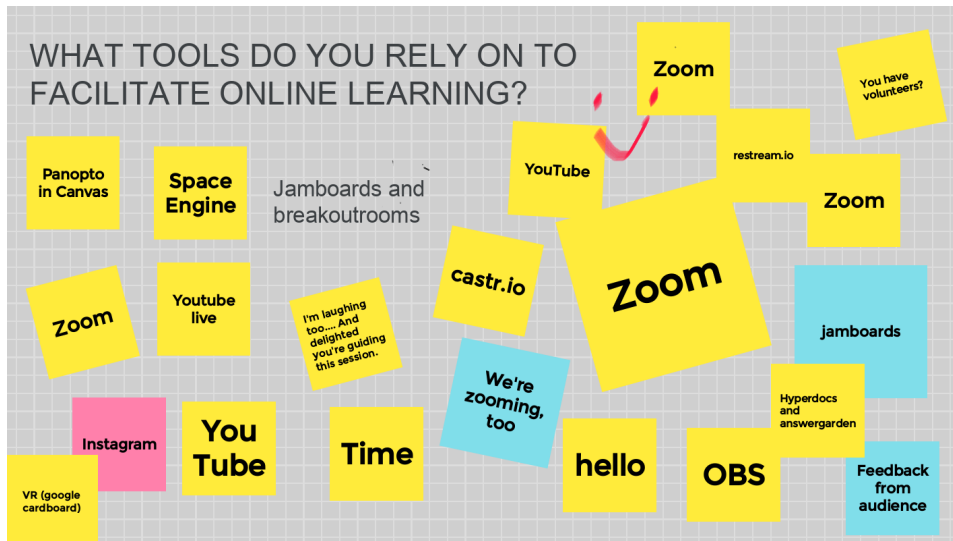


Figure 2. A snapshot of the Google Jamboard for “What tools do you rely on to facilitate online learning?” filled in by some audience members at the 2020 annual conference of the Astronomical Society of the Pacific.

work to users’ advantage in developing meaningful learning experiences without an increased commitment in time or funding.

3. YouTube and Zoom as Streaming Tools for Engagement

In 2020, YouTube had more than two billion monthly users (Newbury 2021). That's more than 25-percent of the world population. According to Pew Research Center (2019), by the end of 2019, YouTube had grabbed the attention of roughly 74-percent of adults in the United States (far ahead of Facebook's 68-percent). The service is even more important on a global scale and for launching content in multiple languages; those same reports indicated that only 17-percent of videos on the platform were produced in English that year. While YouTube Live lacks the ability to host multiple presenters (two) some of the benefits of using YouTube include:

- Access to a global audience with few barriers
- Capability to restrict access by age or to those in possession of a video link
- Pre-scheduling for YouTube Live events, ensuring visibility weeks in advance
- Analytics tracking for videos
- Added captions, automatic captions, and automatic captions translation in some cases, enhancing ADA and multiple-language accessibility. While some limitations existed with artificial intelligence-generated captioning, it continued to improve on a near-monthly basis throughout 2020.

Zoom as a service was hosting 10 million monthly users as of December 2019, but grew to more 200 million in March 2020 and to 300 million in April 2020 (Iqbal 2020). The primary benefits to Zoom have always been the software's ability to host multiple presenters and hosts at one time and its intuitive screen-sharing. Paired together, YouTube and Zoom provide a clean, manageable means of providing multi-presenter content to global audiences. Hosts connect quickly and seamlessly to YouTube Live Studio from the Zoom interface. In newer iterations, Zoom has rolled out automatic captioning on its own platform which exhibits high levels of accuracy. Zoom can also be re-cast directly to Facebook Live. The only drawback of the platform has been that presenters must choose between YouTube Live since, as of writing, Zoom can only re-cast to one platform at a time.

This paper does not examine other software options but acknowledges that paid services such as Streamyard allow for multicasting to more than one social site at a time. OBS Studio (freeware) can provide a multi-layered approach to re-casting: while Zoom recasts to YouTube directly, users can employ OBS Studio to recast to Facebook Live.

Nationwide Livestream Star Party. On April 24, 2020, Whipple Observatory launched *Nationwide Livestream Star Party* in conjunction with Prescott Astronomy Club in Arizona, NASA/JPL Solar System Ambassadors in Indiana, and North Carolina. More than 2,000 computers logged on for the event in the first 24 hours, logging more than 456 hours of watch time. For Whipple Observatory, this marked a turning point in public engagement, where virtual connections in one night nearly caught up to the prior year's total in-person engagement, and launched the Observatory from serving local and regional communities to a worldwide stage, with more than 40-percent of the audience hailing from outside of the United States, and notable attendance from India, the Philippines, Thailand, Vietnam, Mexico, the United Kingdom, and Brazil.

At the time of writing, an additional 800 computers have accessed the recording of the premiere star party.



Figure 3. Amy C. Oliver of Fred Lawrence Whipple Observatory (inset) explains to the audience of Nationwide Livestream Star Party on April 24, 2020 the difference between what they expect to see through a telescope (left) and what they actually see (right). After completion of the live event, captions were automatically added to the YouTube video in English, and the platform's inherent translation service allowed for viewers to translate these captions into the language of their choice, in this case, Arabic.

In May 2020, Whipple Observatory and NASA/JPL Solar System Ambassador Brian Cummins of Virginia launched a long-term partnership with Emil Buehler Perpetual Trust Planetarium at Seminole State College (EBP) and Central Florida Astronomical Society (CFAS). From May to December 2020, the group conducted star parties in nearly every month, attracting thousands of public participants from around the world. The star party eventually became *International Livestream Star Party* with the addition of telescopes in Chile and the Canary Islands. Over the course of the following eight months, the star party series added a pre-stargazing science presentation, which featured speakers from Harvard University, Center for Astrophysics | Harvard & Smithsonian, and the Center for Interdisciplinary Exploration and Research in Astrophysics (CIERA). Guest star presenters in 2020 included Mt. Lemmon SkyCenter, Wichita State University Cohen Honors College, Utah Astronomy Club, and Clark Planetarium.

Aside from planning logistics in advance and conducting a test run of the star party prior to going live, the defining decision for this event was to reserve Zoom for presenters only, inviting the public to join in via YouTube. This allowed presenters to chat freely in Zoom and to resolve tech issues without an audience. Further, this decision eliminated interruptions caused by participants exiting and entering the room or unmuting themselves throughout the meeting. The ongoing success of the program is owed to the stable core team of presenters as well as the addition of invited guest star presenters and speakers.

Smithsonian Storytime and Science Education Videos. In April 2020, with the launch of its YouTube channel, Whipple Observatory began creating story time videos and science education videos for public distribution. Many early iterations of these features were filmed live in the backyards and homes of staff. Later videos, however, were recorded using Zoom, with a photo or video of the preferred setting added to the background. The move to this format represented a significant increase in quality and a reduction in editing time for staff with the elimination of outside and household noises, shadows and poor lighting without the need for added equipment, software or high-level skills. These videos were edited in Adobe Premiere Pro (fee-based software) to create high production values and to add graphics. Staff training for Adobe Premiere Pro was accessed primarily through freely available how-to videos on YouTube.



Figure 4. Amy C. Oliver of Fred Lawrence Whipple Observatory reads JG Kemp's *Astrophysics for People, Snorks, Snorks and Sneeples* (with author permission) in a pre-recorded video made for YouTube. Shadows, lighting issues, and background noises apparent in this video were eliminated in later produced videos by using intelligent backgrounds in Zoom (see Fig. 5).

Smithsonian Storytime. and science education videos were furnished to libraries and cultural institutions as nearby as Phoenix, Arizona and as far away as Victoria, Australia. These videos continue to be created and distributed via YouTube and other platforms.

4. Adobe Spark, Adobe Rush, and OBS Studio as Video Production Tools

Adobe Spark is a cloud-based freeware program that allows drag-and-drop creation of graphics, videos, and single page websites. For video production in particular, Spark allows the quick and free production of quality videos for distribution and use online. For those without the resources to utilize skill-based video production and editing soft-



Figure 5. Making use of intelligent backgrounds in Zoom, Whipple Observatory increased the production value of videos, making it easier for audiences to focus on the content, rather than on shadows, poor lighting, and background noises.

wares like Adobe Premiere Pro, Spark offers a more than reasonable alternative. Some of the immediately noticeable benefits of using Spark to create astronomy education videos include, but are not limited to:

- Easy upload of photos and MP4 video clips, and free stock images
- In-browser voice-over capture and adjustable timing for slides/frames
- Free music library and the option to upload additional music
- In-browser trimming and editing of photos and videos

Also in the Adobe freeware lineup is Adobe Rush, which focuses on mobile, on-the-go video editing. While Spark supports the creation of short videos in a more traditional slide/frame sense, Rush allows for filming, editing and posting straight from a mobile phone. The software does also exist in a desktop version, but is targeted to mobile users. Like Spark, it allows video clip trimming, voiceover and music additions, but in this case, with just a few taps on the phone screen, and allows social formatting.

OBS Studio is a downloadable freeware for PC and Mac with a primary purpose towards recording and livestreaming video. The key benefit to this software lies in its ability to produce video screen captures, and to easily compose scenes made of multiple screen captures. This capability leads to high production values for both recorded and livestreamed video. The software also captures audio, allowing for the production of how-to videos and follow-along instructions. Paired with software that allows for video editing, such as Adobe Spark, Rush, or Premiere Pro, OBS allows for artful creation of constellation hopping how-to videos and science education visuals.

What's in the Sky? In January 2019, Whipple Observatory debuted an unnamed video feature on YouTube to spotlight the upcoming Quadrantids meteor shower. Created entirely using public domain and creative commons content, the one-minute video required less than 15 minutes to produce using Adobe Spark's drag-and-drop features, templates, and embedded music. In January 2021, the annual update required less than three minutes, and was viewed more than 61 times in the first hour after launching on Facebook. In the 13 months that followed, observatory staff created nearly two dozen short videos for social shar-ing and public presentations using the cloud-based software.

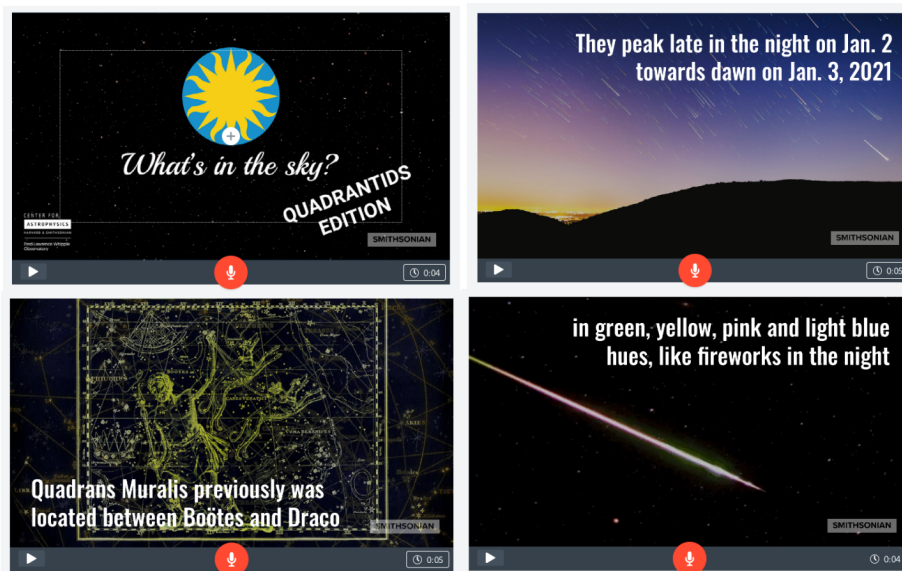


Figure 6. Screen captures from Whipple Observatory's 2021 update to its Quadrantids video, produced using Adobe Spark. The screen captures show in the bottom right, the adjustable time for each slide/frame. The red circle in the center represents the inherent voice-over recording tool. Images used were creative commons with no attribution required. Layout for this grid was created in Canva, discussed in Section 5. Additional *What's in the Sky* videos were created using OBS Studio and Premiere Pro.

In March 2020, staff of the Whipple Observatory undertook a new effort: to create short (two to three minutes) educational star-hopping and constellation guide videos on a weekly basis using OBS for capturing the actions of Stellarium on-screen. Traditionally, film industry guidelines have caused informal educators to shy away from creating video, given the general industry consensus that one minute of video requires one hour of work (Berry 2019). However, Whipple Observatory staff found that the combination of short scripts, gained proficiency in OBS Studio, and pre-designed templates in either Adobe Spark or Adobe Premiere Pro improved efficiency and reduced the time commitment. By the time of writing, most *What's in the Sky* feature videos require less than 1.5 hours to produce. *What's in the Sky* videos have been shared around the world by schools, libraries, museums, and other observatories via Facebook, Instagram, and web site embeds. These videos are also embedded in the Whipple Observatory newsletter, which is delivered to more than 600 subscribers as of writing.

Event Promotion for Mt. Lemmon SkyCenter. Throughout 2020, the flexibility of mobile tools like Adobe Rush allowed Mt. Lemmon SkyCenter staff to create high quality video on the fly while working from home. Videos like this one, created in 2021 for the SkyCenter’s virtual Messier Marathon, were quickly and easily adjusted to different social formats, including the wellknown Instagram square, which also works on Facebook timelines, eliminating the need to produce videos in multiple formats.

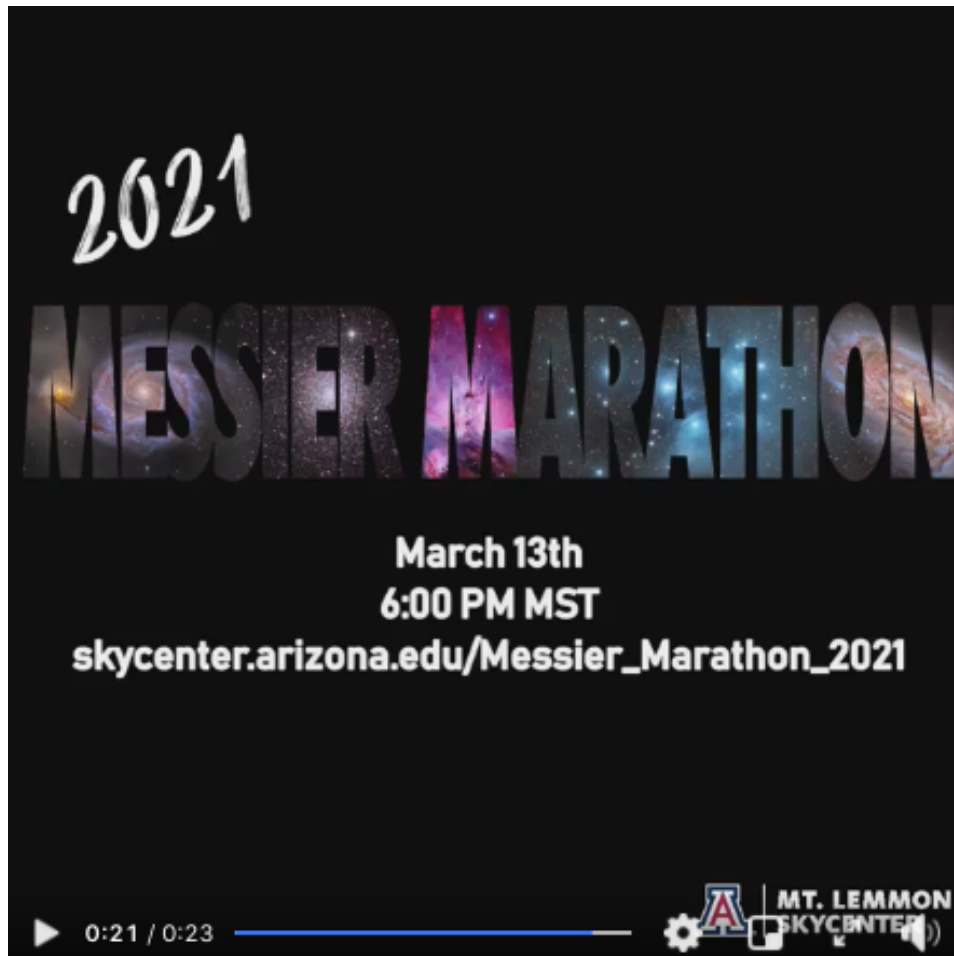


Figure 7. Screen capture of Mt. Lemmon SkyCenter’s Adobe Rush video for the 2021 Messier Marathon. Production and layout by Debbie Federico.

5. Canva and Adobe Spark for Static Visuals in Virtual Engagement

Cohesive and consistent branding in any organization is crucial for brand identity and equity. This makes a difference for all informal educators and informal education programs by connecting educational themes and programs to each other and to the organizations involved. For both the Whipple Observatory and Mt. Lemmon SkyCenter,

branding plays a significant role in all virtual engagements, from online store sales that support educational initiatives to no-cost virtual programming.

As a cloud-based, primarily free tool, Canva is a critical virtual engagement resource for both informal and formal science educators. For-purchase upgrades are available in short denomination and without the enormous upfront costs that typically derail projects and make it near-impossible to access quality design resources. Characterized by preset modules—including flyers, animated images, presentations, social media, etc.—with fully manipulable templates, stock images and upload options, Canva provides an easy and cost-effective drag-and-drop building solution for visuals. The free version of the software further allows easy duplication of a created project and the paid version allows for auto-resizing of work already created, which is particularly helpful for meeting the markedly differing size requirements of Facebook, YouTube, Twitter and Instagram.

Perhaps equally as important is that Canva saves work automatically as the user advances, mitigating challenges presented by unstable and unequal internet access that may traditionally cause users to lose work on cloud-based sites. Internet disruption or dropout will not prevent users from returning to their work, and eliminates the stress of lost time and resources. While intuitive and easy to use on its own, Canva provides hundreds of classes, tips and tricks in its think-tank-style database, free to all users, enabling anyone to create stunning visuals for a variety of uses in virtual engagement.

Canva Visuals for Nationwide Livestream Star Party. In May 2020, Whipple Observatory launched a new look and feel, or brand, for *Nationwide Livestream Star Party*. Using Canva, staff added images, text, and logos for all participating institutions to visuals for Facebook, Instagram, Instagram Stories, YouTube, newsletters and even newspaper and online calendar distribution. The now recognizable imagery tells the audience who's hosting.

Adobe Spark Images for Cohesive Branding at Mt. Lemmon SkyCenter Throughout 2020, Mt. Lemmon SkyCenter staff honed the look and feel of their brand for social media, landing on a mix of script and block text that incorporated the branding colors and fonts associated with the University of Arizona. The result was a clean, instantly recognizable branding set that could be applied to videos, advertisements, social posts and more without having to recreate the styles from scratch each time.

6. Embracing the Tools to Connect in Virtual Environments

At the time of writing, more than 11 months had passed since the widespread shutdown of in-person informal astronomy education experiences throughout the world. Multiple challenges and barriers have presented themselves in the way of constrained time and funding, electronic fatigue and reduced audience attention, and a lack of training in the resources for developing online experiences and engagement opportunities. Despite these challenges, a renewed commitment to creating high-quality, high-value visuals and social spaces for meaningful engagement that reflect the audience can help to maintain and strengthen relationships with the public, ensuring an ongoing connection to the night sky. Prior to and throughout the pandemic, Whipple Observatory, Mt. Lemmon SkyCenter, and their community partners leveraged freeware resources and virtual environments to create impactful online engagement opportunities for the public, increasing their reach to global audiences. By following this example, informal



Figure 8. Branded images and advertising for *Nationwide Livestream Star Party* ensure that the series is always recognizable and that participating groups are given credit for their role in each event. Cloud-based Canva stores logos, images, and finished projects, making updates quick and easy. Layout and design by Amy C. Oliver.



Figure 9. Branded social sale image for Mt. Lemmon SkyCenter featuring Vanessa Gressieux. Layout and design by Debbie Federico.

astronomy educators and institutions can reach out to audiences previously cut-off by the shutdown of in-person events and reinvent the meaning of “connecting” to the sky.

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