COVID Protocols for Portable Planetariums – Fall, 2021

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Abstract. The success of the COVID vaccines, and the return of school children to in-person classes, means that, if cautiously used, portable planetariums can return to being an important tool to Engage, Excite and Educate. This paper presents suggested updated protocols for the use of portable planetariums to ensure safety for the students and planetarium staff.

Background

Portable planetariums are a cost-effective way to excited and engage students. The three-dimensional space has been shown to be effective in teaching three-dimensional concepts (Sumners et al., 2008), and students retain longer when exposed to the content in a dome rather than on a flatscreen (Zimmerman et al., 2014). Using portables extends urban museum outreach into the suburbs and neighboring towns for whom busses would be too expensive and time consuming. In the pre-Covid era, HMNS typically reaches 300,000 visitors annually in the Burke Baker planetarium (200 seats) and 60-70 thousand in portable planetariums for school and camp rentals. Rice University typically reaches 8 to 10 thousand annually in outreach events around the world. These numbers were dramatically curtailed in 2020 and 2021 because of the COVID pandemic. Even now the Houston ISD has curtailed bussed field trips for fall 2021 but allows restricted in-person visits to the schools, so this protocol is more critical.

The COVID vaccines have shown tremendous success in preventing the disease in over 90% of cases, and reducing the severity of cases in the "breakthrough" cases. A recent study published in Lancet (https://www.thelancet.com/journals/laninf/article/PIIS1473-3099(21)00460-6/fulltext) documented the extremely small breakthrough infection rate among vaccinated individuals, reporting that most of the severe breakthrough infections occurred among the elderly, obese or frail. A number of communities have reported that only one or two percent of all COVID deaths in the past month have been vaccinated individuals. Renormalizing with the higher rate of vaccinated individuals, the recent statistic is that unvaccinated are 11 times more likely to die than vaccinated. Thus, with the vaccination rate increasing, and schools returning to "in person" teaching, an update of our 2020 COVID protocols is warranted.

In our previous white paper from June 2020 (http://www.eplanetarium.com/publications/Portable_Planetariums_in_the_Age_of_Covid.pdf), we presented seating charts for 2m spacing in portable domes. This allowed very few to enter the dome safely. With the new 3 foot spacing guidelines, we can now safely accommodate 25 students in the dome per group, enough for an entire class of students to be together in the dome for a presentation. Since the students are together already all day, and since the dome operator is vaccinated, this minimizes the transmission likelihood.

We propose here a suggested seating chart for a 6m dome using mirror projection. Typically the back row of seats (6-12) are folding chairs for teachers or for students with limited mobility.

The remaining students sit on low sand chairs or foam squares to ensure spacing. The suggested capacity is 25 adults (green dots). An additional 5 seats (gray dots) are rather close to the front so have a less favorable viewing angle. If we need to use these sets, we let the children lie down, changing the worst seats in the house to the most desirable. This area is where we place the UV lamp for disinfecting between groups.

Portable planetarium seating

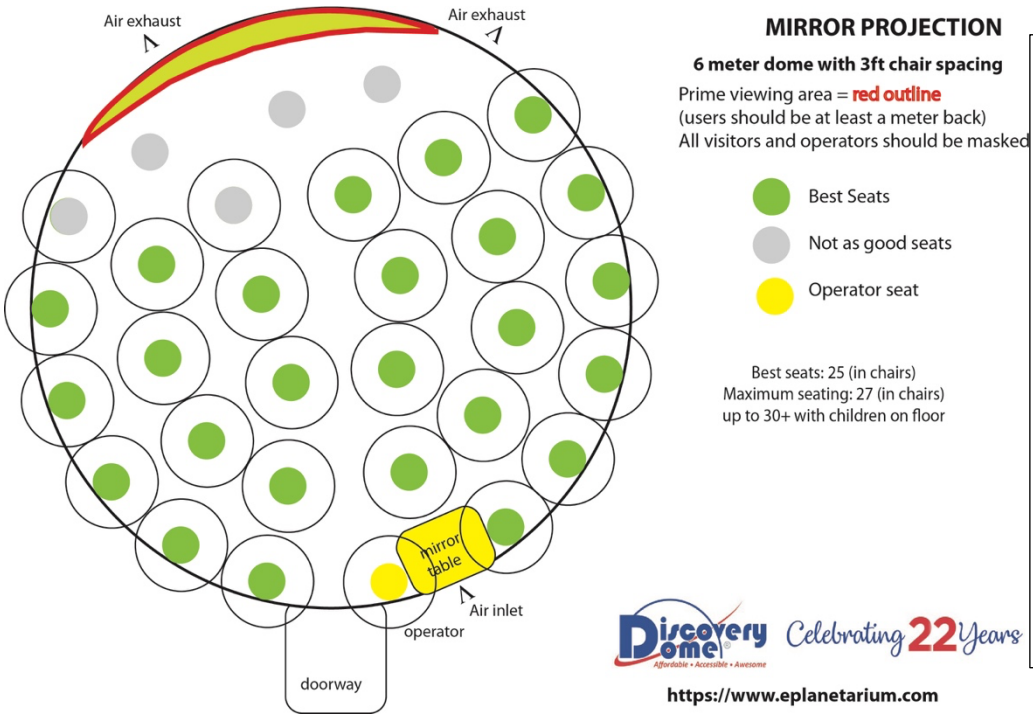

Figure 1. "Socially distanced" seating chart for a 6m dome, with each visitor seated in the center of a 3 foot circle. The airflow crosses from back to front, exchanging the air every 2 minutes.

Before COVID, portable planetarium capacity was a matter of comfort, and we sometimes had to really crowd the people in to maximize the number of visitors. However, for COVID spacing, we must restrict the number of visitors per seating. Generally, in a portable, to maximize seating, we seat adults in chairs in the back, then a second or third row of low chairs, with the children sitting on the floor in the front. The prime part of the screen (red "smile") is across from the mirror, not across from the doorway. The three-foot spacing shown here yields 25 visitors in chairs and/or on the floor, with an additional 5 child seats in the front if needed. The dome shown here is a standard or ringed inflatable "Go-Domes": *http://www.eplanetarium.com/domes.php*

Air Flow

The advantage of a positive-pressure dome is the continuous air flow. For Go-Domes, the air comes in near the projector and exits both out the exhaust vents in the front and out the doorway (if it is unzipped). The typical blowers we use for dome inflation are ¾ HP carpet blowers. A typical ¾ HP blower at high speed setting yields 3450 cubic feet per minute (e.g. https://www.northerntool.com/shop/tools/product_200413814_200413814) and a ½ HP blower can yield 2820 cu ft/min (e.g.

https://www.northerntool.com/shop/tools/product_200610733_200610733) . We typically use the high speed for the initial dome inflation, but reduce the power during the show to reduce fan noise.
The volume of a 6m dome with ½ m horizon line = $(4\pi/6) \times 3^3) + (\pi/2 \times 3^2)$ m^3 = 56.5 + 14.1 = 70.7 m^3 = 2540 cu ft. Thus, the entire air content of the dome will be exchanged **every minute** with a ½ HP blower fan set on "high", or a ¾ HP blow with its fan set on "medium". Since the transmission of COVID is primarily through the air, and the viral load depends on how long air is re-breathed among the participants, this fast air exchange reduces the transmission considerably. To avoid "rebreathing", the dome should be placed in a large room with high ceilings and good airflow, such as a gym or cafeteria.

Vaccination and Masks
It is critical that all adult participants (planetarium staff and teacher chaperones) be vaccinated and masked before they enter the dome. Children under 12 are not at present eligible for the vaccine, so they should be masked. Unvaccinated adults should not enter the dome, for the safety of our planetarium staff.

Decontamination Procedures
It generally takes 2-5 minutes for a group to exit and another 2-5 minutes for the next group to enter. We suggest that the blower be turned on "high" for the entrance, exit, and decontamination procedure. We suggest that between groups, a UV light be placed in the center of the dome and turned on for 5-10 minutes to decontaminate the surfaces and the air. Portable freestanding UV lights cost less than $100 from many online providers, and many have a remote control or timer function. The light should shine for 5-10 minutes and then let the air flow for an additional one minute to remove any ozone created by the light. In this time between groups, the operator will be outside the dome talking to the next group of students, telling them what they will see, and reminding them that if they feel dizzy from the video, just close your eyes!

Figure 2. Sample freestanding UV light to use between groups in the dome. This one has a remote control so the operator can turn it off a minute before the next group of visitors enters the dome.

Summary of the Protocols *(presently used by HMNS)*

1. **Domes used will be 6m diameter (or larger)**
2. **The dome will be set up in a large room with good air flow**
3. **All planetarium staff will be fully vaccinated**
4. **All adults entering the dome will be fully vaccinated**
5. **Everyone in the dome will be masked.**
6. **The shows will be relatively short to reduce viral load (18-20 minutes max)**
7. **The blower will be kept on "high" for the entire session (1/2 HP blower) or on "medium" or "high" (3/4 HP blower).**
8. **The dome will be empty for 6-10 minutes for UV light decontamination between groups. The operator will use this time to introduce the next group of students to the dome and the show.**

Additional protocols used by our UK partners:

1. **A hand-held UV lamp decontaminates the doorway area where visitors touch to enter.**
2. **All handouts/certificates are given to teachers ahead of time in plastic wallets.**

We have begun to use these protocols on the road, and here are a couple of photos from a July trip to a STEM camp in Santa Rosa, Tx.

Figure 3. Author with 24 elementary students after a dome presentation in South Texzas. They all were distanced in the dome and used their masks in the dome but pulled them down for just for the photo.

Figure 4. Author with a group of 15 high school students after a dome presentation in Santa Rosa, TX. The students were masked and distanced in the dome, but some removed their masks for the photo.

About Ozone generators:

Those are more effective but more dangerous than the UV lights. I would only use them in the dome to kill mold or mildew if some has grown on your dome during storage, and NEVER during a session at a school. Set it inside (blower on) with a timer (15-30 minutes) and then let it air out for an hour or more. Ensure NO equipment is inside (projector, mirror, laptop, sound). **Be sure no one is in the dome when the ozone generator is on; AND if it is set up in a relatively small room, people should not be in that outer room either since the blower must be on.** I do not guarantee that it will not cause degradation of the projection surface (I have only used it once). For light mildew, I have set up the dome outside in the sunlight and sprayed the inside (and outside if needed) of the dome with a VERY light spray of Lysol or alcohol and let the sun "bake it out".

Conclusions

The widespread use of vaccines have made portable planetariums safer to return to schools, and minimizes the use of busses to bring students to the museum. These protocols are suggestions; in any case, all local guidelines and regulations should be followed.

References

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